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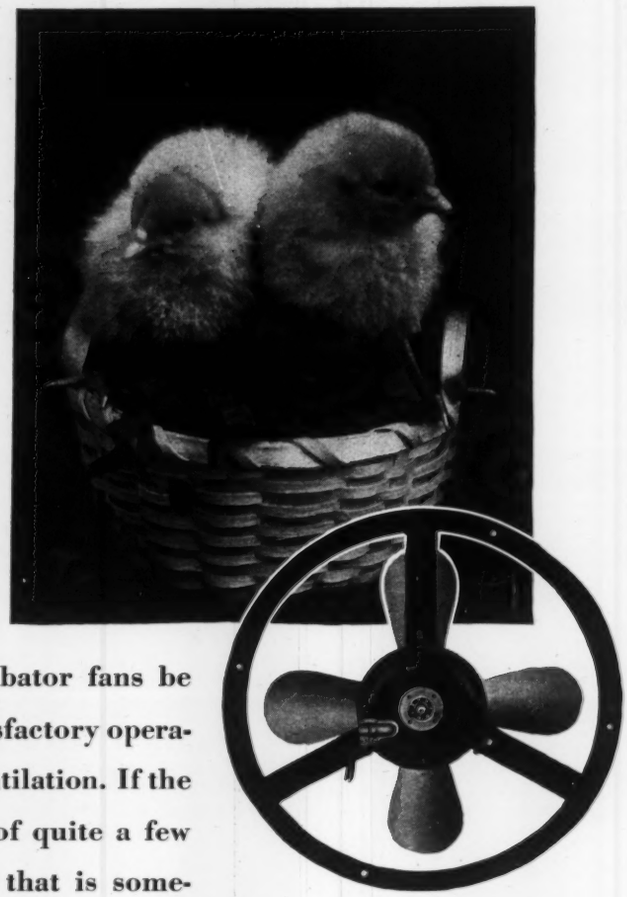
MACHINE DESIGN

AS IT AFFECTS

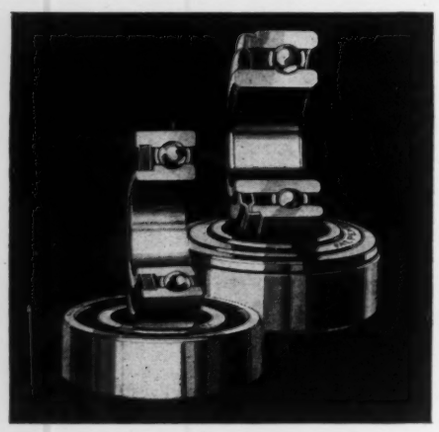
ENGINEERING—PRODUCTION—SALES

If they could talk ~ they would insist upon

PRECISION BEARINGS



Regarding the incubator fan here pictured, Robbins and Myers Sales, Inc., says: "It is essential that bearing performance in incubator fans be perfect because of the extent to which the satisfactory operation of the incubator depends upon proper ventilation. If the fans fail to function, it may mean the loss of quite a few hundred dollars' worth of eggs and a delay that is sometimes more costly. Very frequently, incubator fans are required to operate on non-stop runs of 4000 hours' duration in a constant incubator temperature of 102° Fahr."



Whatever the motor power or speed, there is a PRECISION Bearing that will meet the conditions—at minimum cost per bearing per year of service. Write for the Catalogs. Let our engineers work with yours.

The GREASEAL Ball Bearings used in these fans—all-steel, felt-protected, grease-packed, self-contained—provide the needed stand-up-ability for this service. Furthermore, they simplify design and construction, save machining and mounting, and speed up assembly. And their large grease capacity safeguards against neglect of proper lubrication.

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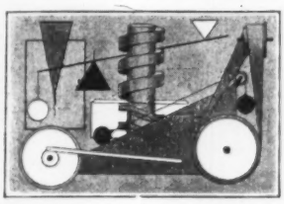
MACHINE DESIGN

as it affects

ENGINEERING–PRODUCTION–SALES

Volume 3 **November, 1931** **Number 11**



Forthcoming ISSUES

NUMEROUS interesting comments have been received on the illustration of Leonardo da Vinci which appeared on page 51 of the October issue, and the biographical sketch on the reverse side of the page drawing. Further comment is invited on these, and on the illustration and sketch of Michael Faraday in the current issue.

Due to the interest evinced thus far, it is planned to publish a series of such illustrations. As with the earlier drawings "Great Moments in Machine Design," consideration will be given to reprinting the present series when complete.

L. E. Jermy

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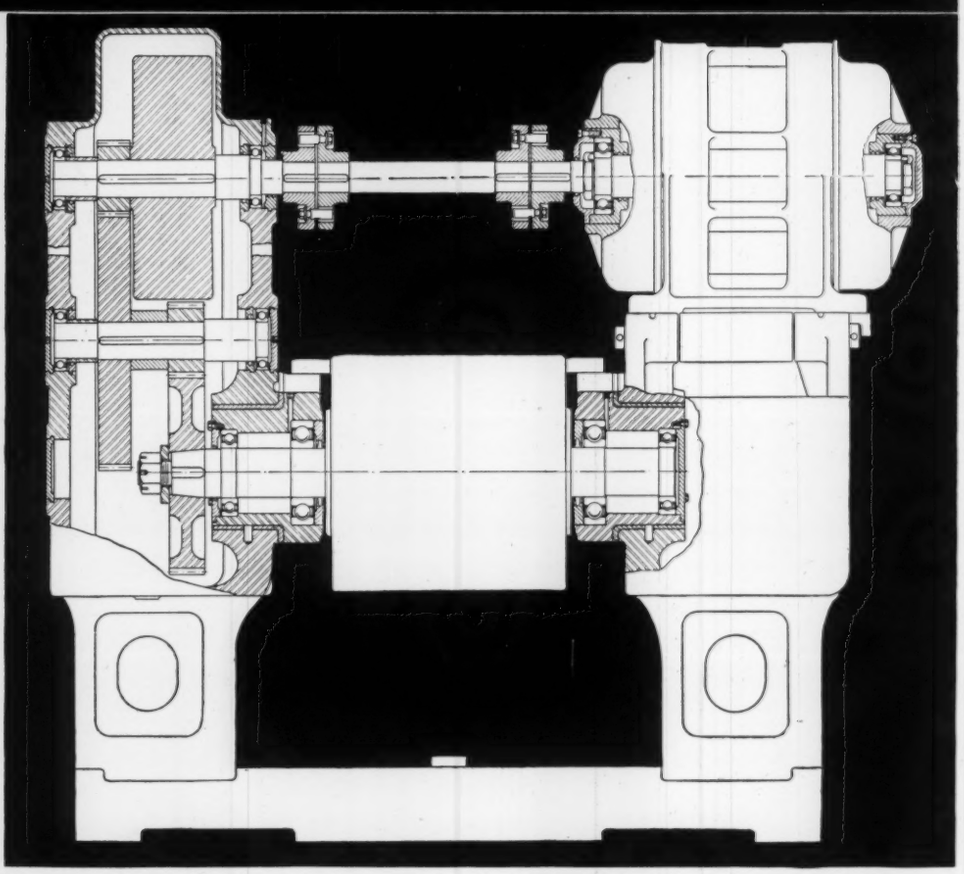
NEW DEPARTURE BALL BEARINGS



The head of an Erie Type M hammer. All shafts are mounted on New Departures, for the good of the user.

1785

Itemized Index, November, 1931

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Compiled for the assistance of engineers confronted with specific design problems

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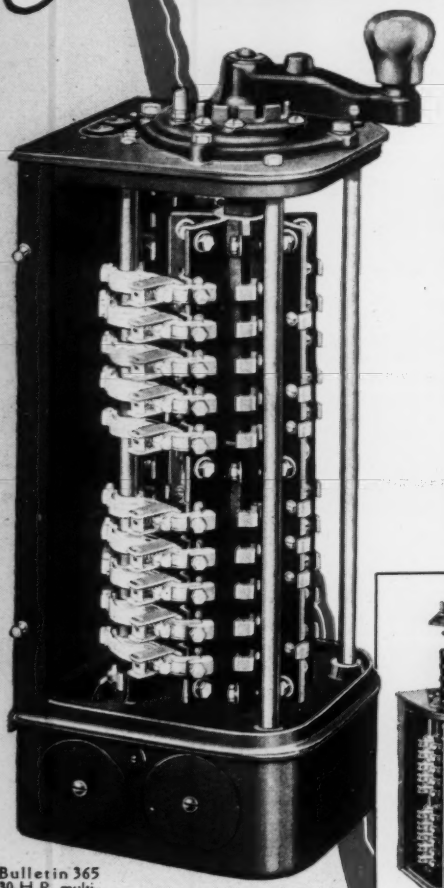
JUDGING from the requests for reprints of the articles on Engineering and Sales Department relationship (July and August 1931 issues), it is evident that deep interest has been created in this subject.

Since the announcement of the reprints in Advertising & Selling, Class and Industrial Marketing, Sales Management, and on page 23 of the October issue, requests for several hundred copies have been received. Just previous to this writing a request was received from a reader in Italy.

If you would like copies of these articles for your own use or for your salesmen, write MACHINE DESIGN, Penton Building, Cleveland.

A New Complete Line for Multi-Speed, Slip Ring

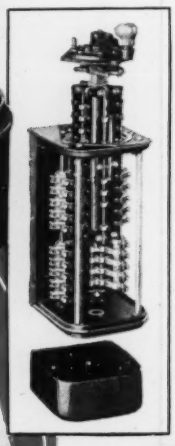


Bulletin 365 30-H.P. multi-speed drum controller.

HERE is another important addition to the fast-growing Allen-Bradley line. This new line of drum controllers and reverse switches is complete, covering every requirement. Because the Allen-Bradley drum controller line was started from scratch, it was easy to incorporate all up-to-the minute features. Herein lies the value and importance of this new line to both machinery manufacturer and user. Only a few models are shown on this page. The complete story with detailed illustrations, dimensions and ratings is now ready in several new bulletins, just off the press. Every machinery builder and every user of this type of equipment should send for these bulletins. Because Allen-Bradley drum controllers are so up-to-date you should thoroughly investigate this line, now!

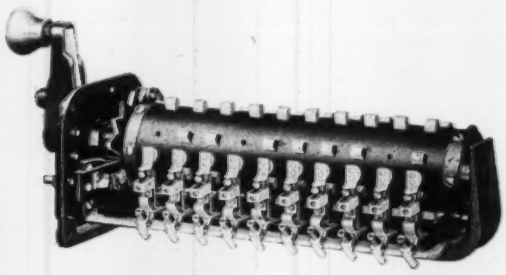
Bulletin 365 Multi-Speed Drum Controllers

This group of drum controllers provides starting, speed changing, and reversing control for two and three phase motors up to 30 H. P., 220 volts and 60 H. P., 440-550 volts. They will handle either separate winding or consequent pole types of multi-speed motors and for variable torque, constant torque, or constant horsepower applications. For ratings above 5 H. P., no motor current is switched on the drum contacts during the speed changes. Bulletin 709 or 710 magnetic starters can be operated by the push buttons in the top of the drum controller and being interlocked with the drum will open and close the motor circuit. The motor can be started and stopped without disturbing the setting of the operating lever. These controllers are easy to wire and are readily built into any machine.



The conduit box is detachable. The drum cylinder assembly is easily removed.

75-ampere contact finger showing removable copper tip, laminated shunt, spring, and adjusting screw.



Bulletin 365 5-H.P. mechanism removed from cabinet for mounting the controller directly into machine frame.

ALLEN-BRADLEY CO.
1333 S. First St., Milwaukee, Wis.

Please send us Bulletins 350, 365 and 375 describing the new line of Allen-Bradley Drum Controllers and Reverse Switches.

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Company_____

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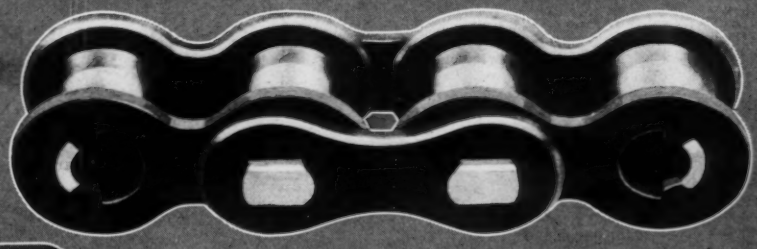

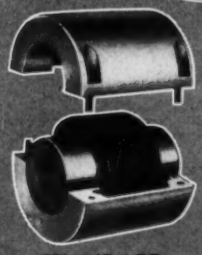

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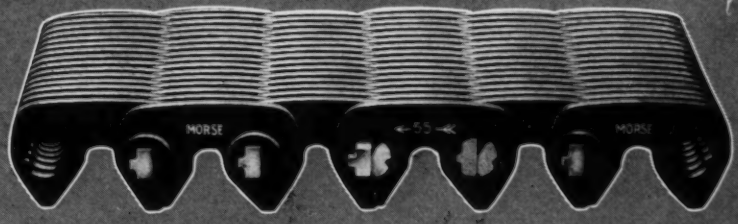

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DIVISION OF BORG-WARNER CORPORATION

CALENDAR OF MEETINGS AND EXPOSITIONS

Nov. 10-13—National Association of Practical Refrigerating Engineers. Meeting and exposition to be held at Rice hotel, Houston, Texas. Edward H. Fox, 435 North Waller avenue, Chicago, is secretary.

Nov. 11-12—American Management association. Included in the papers to be presented at the industrial marketing conference at Hotel Statler, Cleveland, are: "Product and Market Research," by F. B. Heitkamp; "The Use of Engineering Service in Selling," by R. S. Perry; and "Using Salesmen in Industrial Market Analysis," by D. M. Strickland. The 1931 annual business meeting of the association will be held the first day of the conference. W. J. Donald, 20 Vesey street, New York, is managing director.

Nov. 11-13—International Acetylene association. The annual meeting to be held at the Congress hotel, Chicago, will include discussions on: Methods of testing oxy-acetylene welded joints; welding and its future; aircraft, railroad, marine and automobile welding; welding the new alloys; painting, lacquering and enameling welded joints; and engineering education in welding. Prof. S. C. Hollister will discuss "What the Welding Industry Must Do to Receive Engineering Acceptance More Rapidly." A. Cressy Morrison, 30 East Forty-second street, New York, is secretary.

Nov. 18-20—Conference on Metals and Alloys. Technical conference and exhibition at Case School of Applied Science, Cleveland, sponsored by the school and Cleveland Engineering society. Papers to be presented include: "Metallurgy of Alloying," by Dr. A. A. Bates; "Stainless Steel," by Dr. M. A. Grossman; "Monel Metal and Nickel Alloys," by T. H. Wickenden; "Brass, Bronze and Copper Alloys," by W. R. Hibbard; "Zinc and Its Alloys," by W. M. Peirce; "Aluminum and Its Alloys," by L. W. Kempf; and "Magnesium Alloys," by Dr. John A. Gann. The exhibition will include a complete die casting process, special X-ray equipment and demonstrations, electric and gas welding of various alloys and physical and metallurgical tests on alloys. For further information address Fred L. Plummer, Case School of Applied Science, Cleveland.

Nov. 30-Dec.4—American Society of Mechanical Engineers. Annual meeting to be held at Engineering Societies building, New York. Papers to be presented include: "Kinematography in Photoelasticity," by M. M. Frocht; "Photoelastic Study of Shearing Stress in Keys and Keyways," by A. G. Solakian and George B. Karelitz; "Application and Design of the Floating Drive for Conveyors," by N. H. Preble; "Designs of Spring Gears for Exhaust-Turbine Installations," by J. Ormondroyd and T. C. Kuchler; "Forced Vibrations with Non-linear Spring Constants," by J. P. DenHartog and S. Mikina; "Machine-Design Management," by J. L. Alden; "Correlation of Design and Foundry," by Alex Taub; "Oil-Film Pressures in an End Lubricated Sleeve Bearing," by L. J. Bradford; "Cause and Effect of Recent Advances in Textile Machinery," by E. D. Fowle; "Leakage Losses and Axial Thrust in Centrifugal Pumps," by A. L. Stepanoff; "Co-ordination of Research and Engineering with Production and Sales," by C. L. Bausch; "Straight Copper-Lead Alloys versus Solid Solution Bronzes for Heavy Duty Bearings," by F. R. Hensel and L. M. Tichvinsky; "Water-Lubricated Soft Rubber Bearings," by W. F. Busse and W. H. Denton; and "Psychology and Engineering," by E. L. Thorndike. Calvin W. Rice, 29 West Thirty-ninth street, New York, is secretary.

Dec. 10—Steel Founders' Society of America. Meeting of the society to be held at Hotel William Penn, Pittsburgh. G. P. Rogers, 932 Graybar building, New York, is managing director.

Jan. 9-15—American Road Builders association. Annual meeting and exposition at Detroit Airport building, Detroit. Charles M. Upham, 938 National Press building, Washington, is secretary.

Jan. 14—Society of Automotive Engineers. Annual dinner of the society to be held at Hotel Pennsylvania, New York. John A. C. Warner, 29 West Thirty-ninth street, New York, is secretary.

Jan. 25-29—Society of Automotive Engineers. Annual meeting of the society at Book Cadillac hotel, Detroit. John A. C. Warner, 29 West Thirty-ninth street, New York, is secretary.

Jan. 25-29—American Institute of Electrical Engineers. Annual winter meeting at New York. F. L. Hutchinson, 33 West Thirty-ninth street, New York, is secretary.

Jan. 25-29—Second International Heating and Ventilating Exposition. All types of equipment for air conditioning, heating and similar uses will be on display at this exposition, sponsored by the American Society of Heating and Ventilating Engineers. The exhibits will include equipment in operation. Charles F. Roth, Grand Central Palace, New York, is manager.

MACHINE DESIGN

THE JOHNSON PUBLISHING COMPANY, CLEVELAND, OHIO

November, 1931 Vol. 3—No. 11

Better Relations Between Engineers And Parts Salesmen Needed

By L. E. Jermy

Managing Editor, Machine Design

THROUGHOUT this series of articles much emphasis has been placed upon the relations of engineers in design departments with members of the staffs of other departments in the company. The exchange of viewpoints in these pages has established conclusively the desirability of harmonious and co-ordinated effort in management, sales, production and engineering if design activities are to be conducted effectively.

It is no less important that the engineers' relations with individuals outside of their own companies be on the proper basis. In fact, much of the ability of the design man to keep well informed on what is going on in the outside world of technical development depends upon the character of his contacts with those who visit his office.

One of the best disseminators of current information is the salesman of machine parts and accessories. If he is experienced and well posted he can be of inestimable service to designers not only in explaining the advantage of his own wares but also in describing interesting applications, reporting on innovations in practice and recounting evidence of new trends in the field.

Telephone operator: "Mr. Jones (chief engineer) can't see you now. He suggests you talk to our purchasing agent, Mr. Brown"

For this and other reasons it is desirable that engineers in design departments and sales engineers of parts, materials and accessories companies should get together when practical. Unfortunately, however, the problem of making the design engineer accessible to salesmen is not as simple as it appears on the surface. The selection and actual purchase of equipment usually involves not only the engineer and the salesman but also the purchasing agent, and the complications which may and often do arise from this triangle are both numerous and difficult.

The salesman is interested primarily in winning acceptance for his product and in order to succeed he usually must first gain the good will of the purchasing agent. If the prospective buyers' choice of the parts or accessories handled by the salesman depends chiefly upon technical or engineering considerations, then it is necessary that the design engineer must be "sold." The purchasing agent will not buy this type of product unless it is specified or at least approved by the design authority.

Under these circumstances it is natural for salesmen to try to get

the ear of the engineer at every available opportunity. But it is not necessary or desirable for the latter to listen to the story of every salesman who calls at the office. To do so would take too much of his time and besides, the purchasing agent's force is competent to handle many of the routine interviews. Experience has developed a system whereby in the majority of companies the purchasing agent has become a buffer for the engineers. After a salesman has told his story, the purchasing official knows whether or not it is worthy of the time and attention of the design department. Once a salesman has established the proper contacts in the two departments—purchasing and design—he is given considerable latitude and frequently is permitted to deal directly with the engineers. Here, as in many other situations, confidence is the key to opportunity.

The relation between the purchasing agent and the chief engineer constitutes a delicate problem in itself, which will be discussed in greater detail later in this series. For the present we are concerned with the attitude of salesmen and design engineers. In many companies their relations are eminently satisfactory, but in others they fall far short of what is required for satisfactory co-ordination.

In order to help clarify the situation, MACHINE DESIGN presents in this issue a composite letter based on excerpts from letters received from salesmen of companies manufacturing

How Machine Parts Salesmen Regar

SALESMEN of machine parts have no just grounds for complaint against the majority of engineers engaged in design, but unfortunately there is a lethargic minority which has developed an obliviousness to salesmen and sales engineers as a class, and the attitude of engineers of this type justifies severe criticism.

The engineer whose attitude we are going to criticize is his own worst enemy. He is the fellow who invariably shunts the salesman to the purchasing department knowing that the purchasing staff will arrogantly exercise its prerogative of preventing further contact with him.

The salesman resents this deeply, particularly if he has a vital message for the engineer. He has no alternative but to make the best possible presentation to the purchasing department where unfortunately the proper appreciation of technical matters is lacking.

This problem is especially noticeable in some of the larger concerns where it is found to be extremely difficult to get by the purchasing agent to give engineering departments really valuable information. Sometimes, even when engineers accept new developments they do not seem to press their preference, with the result that the part is not incorporated in the product. It is obvious that lack of a sufficiently close relationship between the engineering and purchasing departments and the too common aloofness of engineers frequently causes a loss of time in the incorporation of new ideas, which proves costly to a product's competitive position.

Purchasing Agent: "Your proposition sounds O.K. to me, but I'll have to take it up with our engineering department"

Sometimes an engineer, who has evaded many salesmen by directing them to the purchasing agent, specifies a certain part only to find that the purchasing department is making strenuous efforts in behalf of the acceptance of a competing part. The engineer is in a delicate situation, brought about by his own folly. Having refused to see the salesmen he is not informed on the merits of the various parts under consideration and therefore he is at a disadvantage in his arguments with the purchasing department. Through his neglect, he places his company in danger of adopting a part which no doubt meets the desire of the purchasing agent in regard to price but which has not been examined intelligently from the standpoint of engineering design.

A competent engineer should welcome the efforts of the purchasing department to keep purchases within reason as to price per unit, but he cannot protect himself against imposition unless he knows something about the merits of each part. The best way to keep informed is to listen to competent salesmen or sales engineers.

Too many engineers are over-idealistic. They hold out for a minor principle in a detail against more important practical considerations. In one case a bearing for a redesigned machine was under debate. The selection had simmered down to the choice of two makes. One had been used on the machine for a period of several years and had given a good account of itself. However, its use in similar machines built by competitors had been gradually shrinking. It was slowly fading out of the picture. On the other hand the second bearing was rapidly gaining favor throughout the industry. In fact customers who used the machines preferred the second bearing.

The argument reached the point where the sales manager of the company urged adoption of the second bearing because he claimed his customers wanted it and it was a good sales talking point. The purchasing agent was neutral, because the price of each bearing was about equal. But the engineer held out for the first bearing on the ground it had proved successful in the old machine. The arguments of the sales engineer for the second bearing were that it had been adopted on five out of six of the competitive machines, that its presence in the new machine would stamp it as a modern piece of equipment,

parts and accessories for machines. We believe it conveys an accurate idea of the average salesman's opinion of design engineers. Next month the engineers will be given an opportunity to say what they think of salesmen and sales engineers.

The composite letter is significant in that it attacks the engineers on several points which are almost identical with those touched upon in recent issues by other critics. There is a clear-cut tendency to accuse a minority of design chiefs of conservatism, lack of enterprise, reluctance to depart from tradition, blind adherence to "pet" ideas, etc. These complaints are similar in many respects to the laments voiced earlier in this series by representatives of the sales department and the management of the engineers' own companies.

From the letters received from parts salesmen it is evident that the source of much misunderstanding is the engineer's apparent antipathy to new ideas. It is quite possible that engineers have developed an attitude of coldness as a defense against the many worthless ideas which are brought to their attention. At any rate their reaction to new things seems to have given salesmen the impression engineers are prejudiced against anything new.

Would it not be a good thing for all concerned if this point were clarified? We believe engineers will dwell on this subject in their rebuttal next month.

---

ar Engineering Departments—By a Group of Salesmen

that it had wide user acceptance and that from a purely engineering standpoint it was the equal of the old bearing.

But the engineer was adamant. The old bearing was retained and not until several years later, when it had practically disappeared from the market, did the engineer agree to the incorporation of the second bearing. By that time, it was a common-place part on all machines and the company lost the advantages of "newness," up-to-the-minute design, etc. which it would have enjoyed had the bearing been adopted earlier.

As salesmen for machine parts we think engineers of this type, who are prone to "leave good enough alone," lose their perspective through ignorance of what is going on in their industry. They fail to support their own sales departments as they should. Too often they underrate the importance of customer acceptance of well-known machine parts and accessories.

Like all other mortals engineers have their likes and dislikes and down deep in his heart the parts salesman can't hate them for fostering relationships of long duration. But sometimes it is hard to understand why they close their eyes completely (without even investigation) to new and valuable things.

In this age of unprecedented competition a good engineer should be endowed with commercial instinct, which many salesmen perceive he lacks. Many engineers should be made to realize that they owe it to their company, to their jobs and to their futures to be on the alert for new ideas for a better product, improved production and reduced costs.

A number of engineers are susceptible to superficial sales claims and do not seem to have the ability to appraise true value. Whether this last is a cloak to hide other weaknesses or whether it reflects too great an obsession for purely engineering considerations is an open question. The fact remains that the standards by which a few engineers judge new machine parts are at variance with general experience.

Salesmen naturally know that a new part—especially one that represents a somewhat radical departure from conventional ideas—will not be received with open arms by the engineer until he has had a chance to study it carefully. They expect the engineer to proceed cautiously in adopting anything that is strikingly new. But they cannot understand why this cold reception should take the form—as it often does—of a downright prejudice against new things. There are a certain few in the engineering profession who seem to take an unholy delight in jumping all over a newly created machine part without examining it or listening to a recital of its good points.

This condemnation before trial of innovations has given engineers a reputation for conservatism which many of them do not deserve. But making due allowance for the fact many worthless new ideas come before the eyes of the average chief engineer, we believe a more receptive attitude toward new products—especially those introduced by responsible manufacturers—would be beneficial.

Engineer: "But I don't want to make a change. We have used present bearing for 20 years. Why not leave well enough alone?"

In conclusion, we realize that not all of the criticism of the relations between parts salesmen and design engineers can be laid at the feet of the latter. Salesmen, of course, can be guilty of many abuses, such as for instance, insisting upon seeing an engineer when he is in the midst of emergency work or when their message is more appropriate for the purchasing department.

Nevertheless, after discounting the possible annoyances caused by inconsiderate salesmen, we still think that the attitude of the inaccessible, let-well-enough-alone, slave-to-tradition type of engineer is susceptible to marked improvement.

SCANNING THE FIELD FOR IDEAS

A Monthly Digest of New Machinery, Materials, Parts and Processes, with Special Attention to Significant Design Features and Trends

Mechanizing Delivery of Ice

SINCE inauguration of the cash and carry system in dispensing commodities, the development of coin operated, automatic vending machines has extended into diversified fields. Designers of these machines have experienced singular success and with the trend decidedly in this direction as indicated by the advent of coin operated gasoline pumps (MACHINE DESIGN Nov. 1930, page 27) there exists a wide field of opportunity for engineers in development of units of this kind.

One of the interesting examples of machines of this type is the recently introduced unit for the automatic vending of packaged ice, developed by Booth Engineering Co. Ltd., Los Angeles. These machines are neat and clean and become an attraction in the market place as may be seen from Fig. 1. By inserting a coin in the box a 25-pound package of ice adequately wrapped for convenient carrying is delivered through two small folding doors which are operated from within by the coin-actuated mechanism.

Fig. 1—Automatic ice vending machine is new idea in coin-controlled units

After delivery the ice doors close tightly. The large door in front center is for the service man who oils and inspects the machinery at weekly intervals. The door at the left side over halfway up is for loading packaged ice into the huge cabinet and is at a convenient height from the tailgate of a refrigerated truck. The ice is cut and wrapped at a central station.

At the top may be seen a louvre through which air is drawn to cool a copper condenser unit of the refrigerating plant. Air is discharged through a similar louvre on the opposite side, which also serves as a door for the service man to inspect the refrigerating unit, switchboard for the entire machine and electric clock which controls the lights as the machine operates twenty-four hours daily. The temperature inside is maintained at or near 20 degrees Fahr.

When such perishable commodities as ice can be marketed by coin-controlled automatons, it is only reasonable to consider that scores of other products which the everyday shopper buys could also be handled profitably in this manner. Coin-controlled machines are found wanting in the out-of-the-way places, particularly where the volume of sales does not merit the employment of salesmen or attendants. This pertains particularly to the distribution of gasoline.

Television Becomes Practical

WITH engineering and development work on radio receivers having reached well up the scale of perfection, it naturally is expected that the results of the incidental research be applied to the new field of visual reception or television. Scientifically, television is a fact but it is only recently that a commercial unit for the home was materialized. The new Jenkins television receiver announced recently is among the first.

One of the features of the Jenkins set is its interchangeability, permitting the operator to plug in the unit which covers the usual broadcast bands, or when television is desirable he can bring the corresponding unit into the cir-

cuit. A third unit is available for covering the short wave bands. This combination in a receiver is particularly synonymous with good design.

With Nov. 2 the eleventh anniversary of radio broadcasting marking the inception of KDKA, radio has made rapid strides. Now television points the way toward further progress. In the design of this type of equipment it has been found that minor electrical and mechanical changes do not inspire the public to cast aside old radio sets. Only a revolutionary discovery which will warrant replacement will create a new wave of buying.

Television seems to hold the key to this new impetus. Another development on which manufacturers are basing hope is the "cold tube." No light socket current is required, since a small battery will operate it for a long period, it is said. Two of these tubes give sufficient volume. Dr. August Hund, formerly of the bureau of standards, is adding the finishing touches to the device.

Machine Controls Room Atmosphere

IN THE October issue of MACHINE DESIGN the new room coolers developed by Frigidaire Corp. were described briefly. Fig. 2 shows the cube type cooler of this class of new equipment which may be suspended from the ceiling, recessed in the wall, or placed behind grilles.

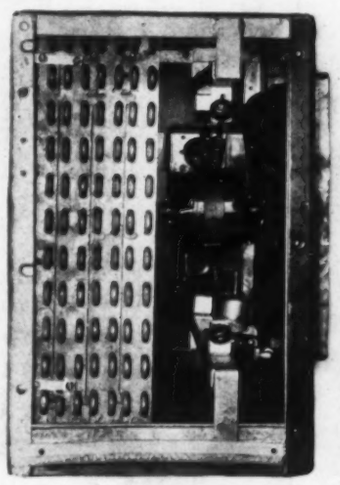


Fig. 2 — Cube type cooler draws warm humid room air in at the rear, extracts heat and moisture and expels it by means of a motor fan suspended by springs

The warm humid room air enters the cabinet at the rear, passes through the cooling coil which extracts a large portion of the heat and moisture, and then is forced out at the front. In the vertiflow model, however, the air leaves the cabinet at the top.

Suction of the air into the unit is performed by a powerful fan which forces the reconditioned air out into the room at the rate of approximately 650 feet per minute. An interesting design feature of this machine is the spring suspension of the motor. In preventing vibration and consequent noises this method of mounting the operating section is particularly efficient.

An additional design detail of this room cooler is a drip pan beneath the coil to catch any excessive moisture which may collect on the cooling surfaces. The compresor is remotely installed and is connected to the cabinet by the conventional refrigerant lines.

Speeding the Unloading of Grain

UNLOADING from 4000 to 6000 tons of wheat in a 24-hour day is accomplished by a new electric car tilting device. In designing this mechanism Westinghouse and Link-Belt Co. engineers bring to the disposal of large flour mills a unit which long has been needed. Rapid disposal of grain is necessary at harvest time and by virtue of a simple unloading operation much wasted time is avoided.

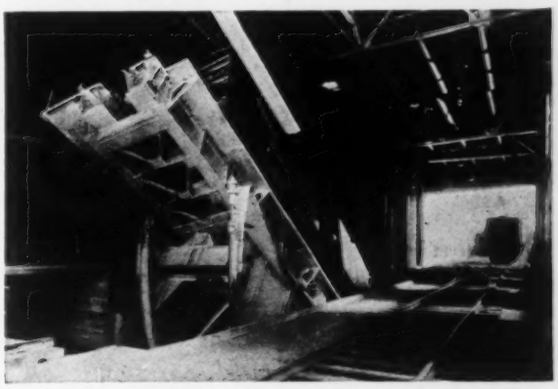


Fig. 3—Electric car-tilting unloader designed for rapid disposal of wheat

The device constitutes essentially, as shown in Fig. 3, a short section track forming the diameter of a pair of semicircular tracks beneath them, together with a mechanism which tips the car slightly sideways. Oscillation of the car 40 degrees either way from the horizontal causes the grain to pour out of the opening through a screened weighing hopper. Finally, a mechanically operated arm or "cant" is thrust into the car door at such an angle that what wheat remains is skidded out at the last tilt. All of this is accomplished by motors and automatic controls. It is as impossible, however, for the operator to vary the cycle of operation once started, as it is for him to start the cycle until an electric eye located in the pit beneath the tracks, sees that everything is in readiness to start. The eye acts by means of a beam of light which can only reach it when the tracks are level with the approach tracks, along which the cars are brought to the unloader.

Hydraulic Ram in Ship Design

METHOD of operation of the pilot house raising and lowering gear on new Ford freight ships when passing under low bridges is an adap-

tation of the hydraulic ram principle widely used commercially for elevators and such equipment. In developing this unique feature for cargo carriers the Great Lakes Engineering Works, River Rouge, Mich., have incorporated design innovations which are interesting.

As shown in Fig. 4 the pilot house is in the raised position. Because of its mobility all controls, steering gear and signals between it and the various quarters of the ship are electrically operated. The actual raising gear of the house consists of a plunger, rigidly attached to the bottom of the pilot house at the center of gravity and extending down into a cylinder fastened to the rigid structure of the ship. The plunger is made of 12-inch heavy pipe and the inside of the plunger is used as an oil reservoir.

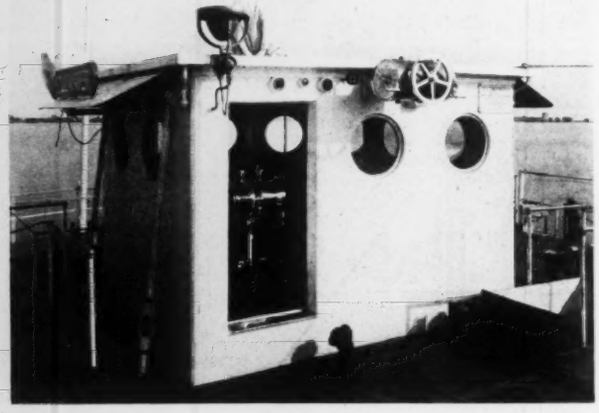


Fig. 4—Hydraulic ram principle facilitates raising and lowering of pilot house

A motor driven rotary pump draws the oil from the reservoir and discharges it into the cylinder when the pilot house is to be raised. When it is desired to lower the house a bypass valve is opened, allowing the oil to flow from the cylinder back into the reservoir. By using the plunger as a reserve oil reservoir and by placing the rotary pump on the movable pilot house, no flexible connection is necessary in either suction or discharge lines. Suitable check and stop valves are installed in the line so as to seal the oil in the system, thereby allowing the pilot house to remain at rest at any desired height.

Two New Plastics Are Developed

MORE extensive use of plastics in design intensifies the interest in two newly developed materials, "Plaskon" and "Sakaloid" The former is a heat reactive molding compound now being produced commercially by Toledo Synthetic Products Inc., Toledo, O.; the latter, the principal constituents of which is polymerized sugar, is reported by a British engineer, Arthur F. Ford, who developed it.

Fabricated Plaskon is described as unexcelled in color possibilities, combining bright shades with a hard lustrous surface. Properties of the materials as given in a research report of the Mellon Institute of Industrial Research include a specific gravity of 1.43; tensile strength 4000 to 6000 pounds per square inch; impact strength 0.7 to 1.2 foot pounds; unaffected by alcohol, acetone, oil or other common solvents; scleroscope hardness 80 to 95; capable of being machined, bored, resurfaced and polished; moderately resistant to cold dilute acids; quite resistant to cold dilute alkalies.

Sakaloid varies from a water-soluble gel to a hard brilliant water-white solid which can be molded by casting in open forms or by reducing to shreds and then molding under pressure. Although experimental results have not yet been released for publication, it is said that by virtue of its mechanical properties it can be produced through a long range of flexibility, beginning with the softness and elasticity of crude rubber and reaching a glassy hardness.

Centerless Grinder Finds New Uses

BECAUSE of the interest designers have in the new processes of production, the modified centerless grinder developed by Cincinnati Grinder Inc., Cincinnati, is particularly pertinent. This machine and method as illustrated in Fig. 5 is claimed to double the production of relieving pistons by grinding.

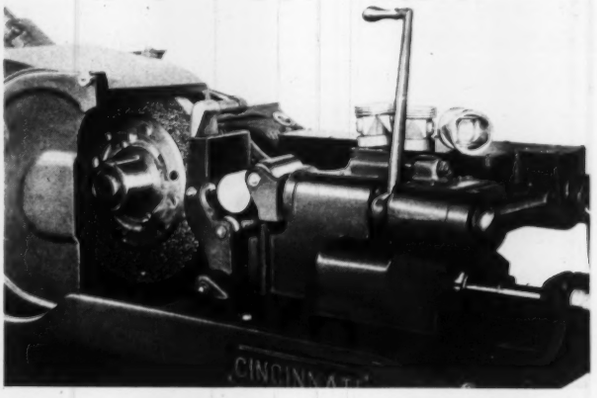


Fig. 5—Centerless grinder can be adapted to handle a variety of cam-shaped parts

The piston is supported by three sets of rollers and as the operating lever is brought down the upper roll at the right brings the work forward to its pivoting support and exerts the proper pressure on the work for grinding. Besides piston relief finishing, this method of grinding can be applied to a variety of cam-shaped work.

Protecting Machines Through Spring Mountings

By J. Ormondroyd

WHENEVER it is felt desirable to protect the surroundings of a machine from disturbances incident to its operation, engineers instinctively resort to flexibility between the machine and the foundation on which it is mounted. This instinct is old, but the rational quantitative design of spring mountings is comparatively new, at least in this country. Spring mountings were made long before the principles of their design were known. The earliest rational discussion of flexible mountings in this country was given by N. W. Akimoff about 15 years ago and the first complete quantitative analysis of the subject by C. R. Soderberg* only eight years ago.

Spring mountings are used to mitigate the effects of impactive forces and periodic forces. The latter case is by far the most important to engineers since nearly every machine which rotates gives rise to periodic forces during its operation. The commonest causes of periodic forces are unbalance and other inertia forces of the moving machine parts, and variable torque reactions.

These periodic forces are transmitted to the foundation of the machine and cause destruction or discomfort in the immediate surroundings. Everyone is familiar with the irritation caused by engine vibrations in automobiles. Less familiar are the peculiar vibrations caused in structural steel buildings by the elevator machinery mounted in the pent-house. These vibrations are peculiar in that they appear at widely separated floors in the building at the same time, because of the distribution of antinodes in the structure's mode of motion. Single phase frequency changers have been known to shake bricks out of substation walls. Law suits have been instituted because of vibration transmitted through the ground to buildings far away from the machine which was the source of the disturbance. Troubles such as these now are avoided almost universally by flexible mountings.

*C. R. Soderberg—*Electric Journal*, April, 1924, pp. 160-165.

GREAT care must be exercised in designing flexible mountings as vibration may be increased rather than reduced by incorrect application. MACHINE DESIGN is fortunate in having had Mr. Ormondroyd, manager of the Westinghouse company's South Philadelphia works, prepare a two-part series on this subject, of which this is the first section.

Improper Spring Mounting Aggravates Condition

Flexible mountings have one peculiarity which makes it necessary for the engineer applying them to know the fundamental principles involved. This peculiarity is that it is possible to make the disturbance worse rather than better by improper spring mounting. In fact, by following the usual instincts, it is almost inevitable that the situation will be made worse. While the engineer instinctively resorts to flexibility he, also by instinct, fears large deflections in the flexible parts. An effective spring mounting must have comparatively large deflections under its load and a spring with small deflections usually only makes the transmitted vibration worse.

The situations in which spring mountings are used commonly are shown schematically in Fig. 1. The theory of spring mounting for the situation shown at *a* is somewhat simpler than for *b*; it is given in the following.

Of most interest is the magnitude of the disturbing force transmitted to the foundation. This force will depend on the motion of the machine and the stiffness of the spring between the the machine and the foundation. It is easy to see that small motions in the machine and great flexibility in the spring will lead to small transmitted forces.

The motion of the machine, assuming the non-

existence of friction forces, can be found by using Newton's second law of motion (mass times acceleration=force)

$$m \frac{d^2x}{dt^2} = -kx + P_o \sin \omega t \quad \text{.....(1)}$$

where

m = mass of machine W/g in pounds second^2 per inch
k = stiffness of spring mounting in pounds per inch
P_o = amplitude of disturbing force in machine in pounds
ω = $2\pi \times$ the frequency of the disturbing force per second
x = amplitude of motion of machine caused by disturbing force in inches

By assuming that $x=x_o \sin \omega t$ and substituting in (1) the motion is found to be

$$x = P_o \frac{1}{k - m\omega^2} \sin \omega t \quad \text{.....(2)}$$

The transmitted force $P_t=kx$ or

$$P_t = P_o \frac{k}{k - m\omega^2} \sin \omega t = P_o \frac{1}{1 - \frac{\omega^2}{\omega_c^2}} \sin \omega t \quad \text{.....(3)}$$

where

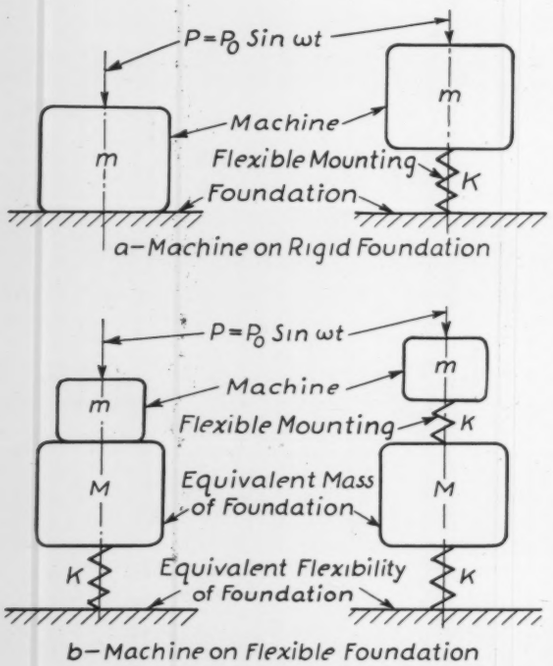
$$\omega_c^2 = k/m$$

The ratio of the transmitted force to the disturbing force, called the transmission factor ϵ by Soderberg, is

$$\epsilon = \frac{1}{1 - \frac{\omega^2}{\omega_c^2}} \quad \text{.....(4)}$$

This factor is plotted in curve *a* Fig. 2.

If damping proportional to velocity is assumed to exist (and no actual system is without damping of some kind), Newton's equation of forces becomes



$$m \frac{d^2x}{dt^2} = -c \frac{dx}{dt} - kx + P_o \sin t \quad \text{.....(5)}$$

where c=damping force per unit of velocity in pounds second per inch and the motion of the machine is

$$x = \frac{P_o}{\sqrt{c^2\omega^2 - (k - m\omega^2)^2}} \sin \left(\omega t - \tan^{-1} \frac{c\omega}{k - m\omega^2} \right) \quad \text{....(6)}$$

If damping is caused by friction or hysteresis in the spring mounting itself, which is the usual case, the transmitted force

$$P_t = c \frac{dx}{dt} + kx \quad \text{.....(7)}$$

since all the actions of the spring on the machine must have equal reactions in the foundation. Then by substituting (6) in (7) the transmitted force

$$P_t = P_o \sqrt{\frac{c^2\omega^2 - k^2}{c^2\omega^2 - (k - m\omega^2)^2}} \quad \text{.....(8)}$$
$$\sin \left(\omega t - \tan^{-1} \frac{c\omega}{k - m\omega^2} + \tan^{-1} \frac{c\omega}{k} \right)$$

Since only the magnitudes of the forces involved and not their phase relationships are of interest at this point, the ratio between the transmitted force and the disturbing force is

$$\epsilon = \sqrt{\frac{\frac{1}{\rho^2} \frac{\omega^2}{\omega_c^2} - 1}{\frac{1}{\rho^2} \frac{\omega^2}{\omega_c^2} - \left(1 - \frac{\omega^2}{\omega_c^2}\right)^2}} \quad \text{.....(9)}$$

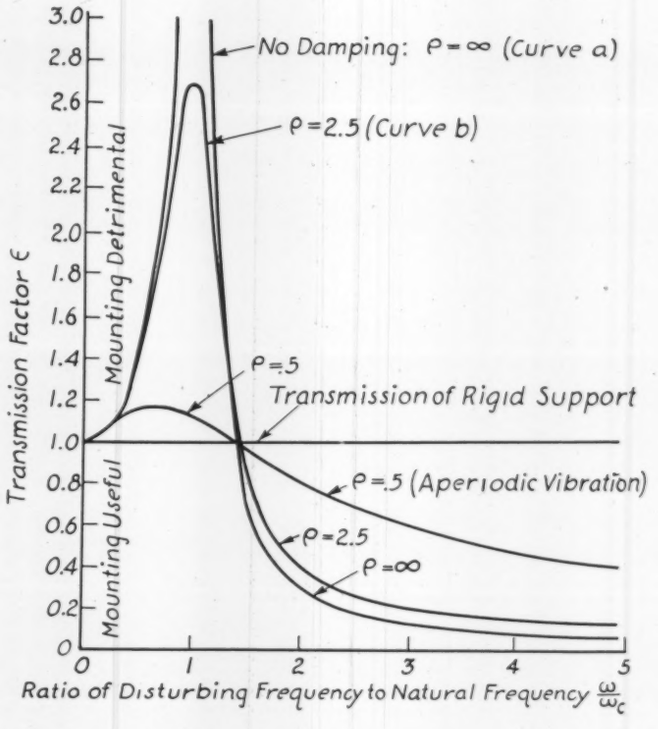


Fig. 1—(Left)—Schematic view of spring mounting systems. Fig. 2—(Above)—Transmission factors with and without damping

where $\rho=\sqrt{km}\div c$ the magnification of the motion when $\omega/\omega_c=1$. This is plotted in curve *b* Fig. 2.

The value of ω or ($2\times$the frequency of the disturbing force) is known from the nature of the disturbing force. For instance, if the disturbance is caused by unbalance the frequency is one cycle per revolution; if it is caused by magnetic forces in some piece of alternating current apparatus it is twice the line voltage frequency. The mass of the machine to be mounted is known and the stiffness of the spring mounting is chosen deliberately in the design of the mounting, therefore, $\omega_c^2=k/m$ is known and controllable.

From Fig. 2 it can be seen that if ω_c is greater than ω the spring mounting makes the transmitted force greater than that which would occur in a rigid connection. In fact up to the ratio between the disturbing frequency and the natural frequency of the machine on its mounting of $\omega/\omega_c=1.4$, the spring mounting makes the transmission worse. Where ω is large compared to ω_c, the transmission becomes small. Fig. 2 also shows that damping is useful in the range of $\omega/\omega_c=0$ to 1.4 but for $\omega/\omega_c>1.4$ it increases the transmitted force.

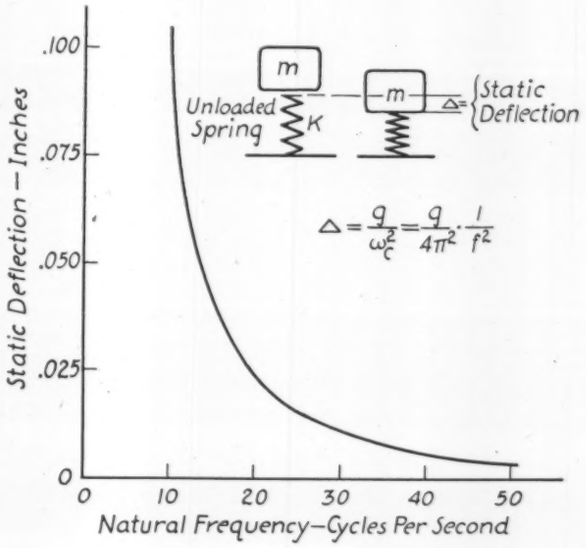


Fig. 3—Natural frequencies as they vary with static deflection

The danger of building a spring mounting without knowing these facts lies in the possibility of putting in a spring so stiff that the operation of the system lies in the worst range around $\omega/\omega_c=1$. To illustrate how the natural instinct for rigidity may lead to mistaken applications, Fig. 3 shows the static deflections in the spring mounting which are associated with various values of natural frequency ($\omega_c/2\pi$). The rapid increase of the static deflections as ω_c is made lower indicates that it is far easier to design spring mountings for high frequency than for low frequency disturbances. Many electrical machines which must be spring mounted to minimize unbalance disturbances run around 1800 revolutions per minute. The disturbing frequency is, therefore, 30 cycles per second. To get a transmission factor of 0.125, the natural frequency of the machine on its mounting must be 10 cycles per second. This corresponds to a static deflection of 0.100 inch—a deflection which appeals to the conservative instincts of engineers as enormous in any machine part.

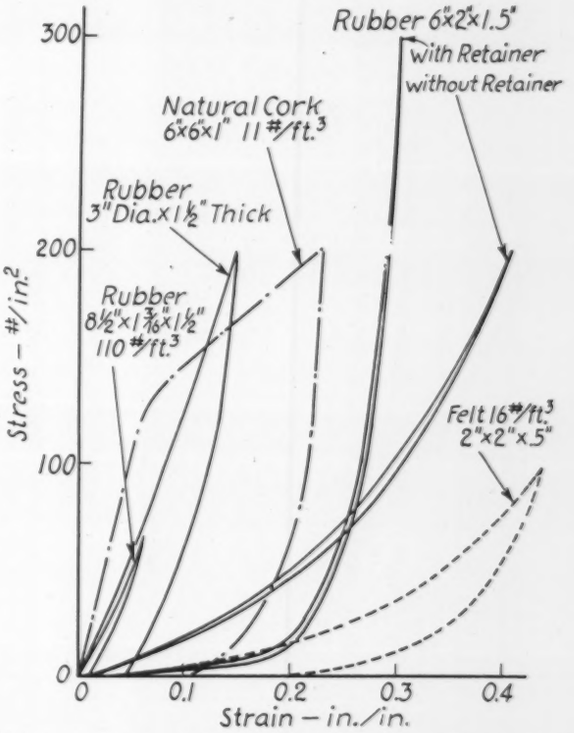


Fig. 4—Results of static compression tests on organic materials

By a more complicated mathematical analysis, which will not be given here, it can be shown that the system shown in Fig. 1 (*b*) has the smallest transmission factor with the lowest possible value of $\omega_c^2=k/m$ as in the case of Fig. 1 (*a*). This is true whether the transmission is considered to mass *M* or to the earth itself.

Fig. 2 indicates that for constant speed machinery (with corresponding constant disturbance frequency) damping in the flexible mounting is to be avoided. For machines of variable operating speeds, damping may be necessary in the event of operation at the natural frequency of the system.

The chief engineering problem connected with spring mounting lies in the design of the springs with large static deflections coupled with safe stresses. Engineers in attempting to solve this part of the problem have used metallic springs of many shapes and combinations and organic materials such as rubber, cork and felt. The secret of success in the spring design lies in the use of large volumes of spring material in restricted

places. Take, for example, the simplest type of metallic spring—a round wire—and suspend a machine of weight W from it. If this suspension is to insulate the point of suspension from the machine disturbances at a given frequency, an infinite number of wires of different diameters and lengths will give the required static de-

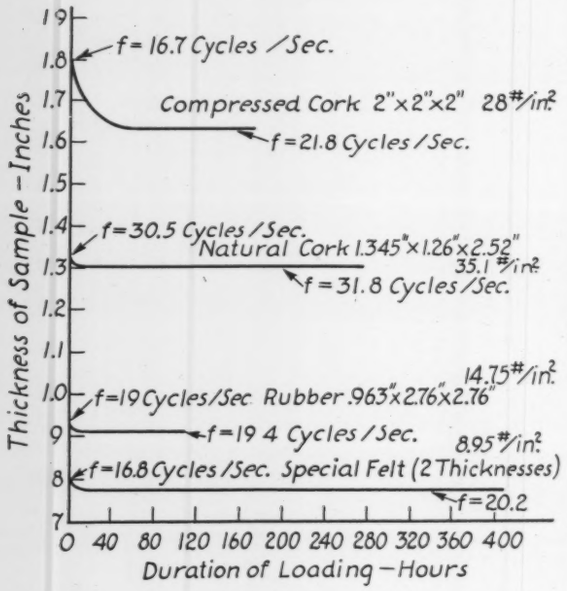


Fig. 5—Results of dynamic tests on compressed and natural cork, rubber and special felt

flection but the stresses will be too high in all of them with diameters below a certain value. Assuming a steel with maximum static stress of S pounds per square inch, the cross sectional area will be $A=W/S$; the static deflection will be $\triangle=WL/EA$ and the volume of material will be LA. Here L is the length of wire used and E is its molulus of elasticity.

The desire for low stress will lead to a large value of A and if $\triangle$ is to be large the value of L must become larger as A increases. Since L and A tend to increase with increasing $\triangle$ and decreasing S, the volumes of metal employed will be relatively large for a safe design if the magnitude of W is fairly large. A coil spring to give the same $\triangle$ and an equally safe stress (in shear) would take a greater volume of metal. To compare the two take a straight steel wire in tension and a steel coil spring in shear. Let $W=1000$; $\triangle=0.1$; the tension stress $S_t=20{,}000$ pounds per square inch; and the shear stress $S_s=12{,}000$ pounds per square inch ($S_s=0.6\ S_t$).

This will require the use of 150 inches of ¼-inch diameter wire or 7.5 cubic inches of steel for the straight wire; and 1.75 turns of 1-inch diameter wire with 4.5 inches mean diameter and 18.5 cubic inches of steel for a coil spring. Although the coil spring weighs 2.5 times as much as the straight wire, it can be installed in a space 2 inches deep by 5 inches diameter and most engineers would employ it instead of the long straight wire.

Metallic springs give rise to little damping. They are, therefore, especially suitable for cases where the disturbing frequency is constant.

For variable frequency of disturbance, damping is desirable since the natural frequency of the machine on its mounting may coincide with the disturbing frequency. Good examples of this are the spring mountings used on automobiles and vehicles which roll on rails. Here it is not a periodic force which acts on the body but a periodic motion which is impressed on the wheels from bumps on the road or rails. The principles governing the transmission of these disturbances to the automobile or car body are exactly the same as those governing the transmission of forces to the foundation of the machine. The attempts at damping the motion of automobile bodies are well known. In rail rolling stock the problem is not so acute as in automobiles; still attempts have been made to damp the lateral motion of interurban cars by introducing friction damping into the lateral flexibility (swing links).

Organic materials are attractive to spring mounting designers chiefly because of their enormous flexibilities. They usually are used under compression at comparatively small stresses, 100 pounds per square inch or less. In this stress range rubber is anywhere from 20,000 to 50,000 times as flexible as steel for similar shapes, and cork is from 2000 to 5000 times as flexible as steel.

Properties of Organic Materials Vary

The physical properties of organic materials are not as simple as those of metals. The load-deflection curve of a block of organic material is a function of the volume, stress method of loading and support as well as of the material itself. Fig. 4 shows some static tests on rubber, cork and felt. On top of this they usually dissipate large amounts of energy when loaded and unloaded cyclically. The properties frequently change with time.

Whenever organic materials are used for spring mounting, load-deflection tests should be made on the actual pads or blocks since stress-strain curves in themselves have no meaning for these materials. Static tests of organic materials are not always sufficient to provide the data for predicting its dynamic behavior. The ideal test of these materials must be a dynamic test. Blocks of the material to be tested should be placed under metallic weights heavy enough to give the required loading. The weight should be set in vibration by impact and a vibration record or die-away curve taken. This record will show two things—the natural frequency and the rate of energy dissipation. If the test is

repeated on the setup periodically, the effect of time under the continued static loading can be found. The same tests can be carried out with continuous forced vibration, although this type of setup does not lead to easy energy loss measurements. E. H. Hull* has published some data on tests made in this manner. Some of his results are shown in Fig. 5. This shows the progressive change in time of dimensions and stiffness of various materials such as natural cork, synthetic cork, felt and rubber. It must be remembered that a tremendous number of different corks, felts and rubbers exist, all of which would give different results under the same test conditions. The curves shown are merely of examples of the general idea.

One fundamental principle, applicable alike to steel and organic materials, is that the largest possible volume of material must be used. Although organic materials cannot be said to have a constant modulus of elasticity; for each particular job they do have a property which is equivalent to an overall modulus. In compression the spring constant of the pad can be written

$$k = E\,\frac{A}{T} \qquad (10)$$

where

k = spring constant in pounds per inch
E = equivalent modulus of elasticity in compression for particular job at hand in pounds per square inch
A = loaded area of organic material in square inches
T = thickness of block or pad of organic material in inches

If A is large, T must be made correspondingly large or else k will be large, and the object is to

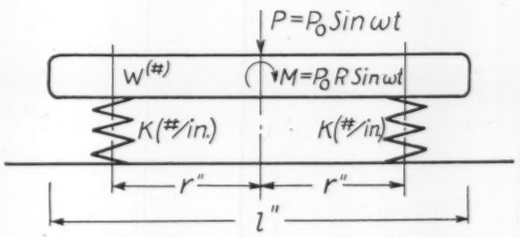


Fig. 6—Schematic view of spring mounting system with disturbing force and moment

get the smallest value of k consistent with long life of the spring material. Pads of rubber and cork loaded over large areas and having small thickness are seen frequently in use. Such an arrangement can be effective only for high frequency disturbances and most of the disturbances feared have comparatively low freuencies.

All that has been said concerning periodic forces applies directly to periodic moments. For forces substitute moments, for masses substitute moments of inertia and for spring constants substitute torsional spring constants. The same linear springs are used to spring mount machines against torsion as are used against linear motion.

A simple example will show the two types of motion considered. Fig. 6 shows a uniform beam mounted on two coil springs and acted upon by a periodic force and a periodic moment both of the same frequency. The following table shows the comparison of the two types of motion.

Specification	Force	Moment
Disturbance	$P_o \sin \omega t$	$RP_o \sin \omega t$
Inertia	Mass $= \frac{W}{g}$	moment of inertia $= \frac{l^2}{12}\,\frac{W}{g}$
Elasticity	spring constant $= 2k$	rotational spring constant $= 2kr^2$
ω_c^2	$\frac{2kg}{W}$	$\frac{2kg}{W} \times \frac{12r^2}{l^2}$
Transmission factor	$\frac{1}{1-\frac{W\omega^2}{2kg}}$	$\frac{1}{1-\frac{W\omega^2}{2kg} \times \frac{l^2}{12r^2}}$
Amplitude of force transmitted at each spring	$\frac{P_o}{2}\,\frac{1}{1-\frac{W\omega^2}{2kg}}$	$\frac{RP_o}{r2}\,\frac{1}{1-\frac{W\omega^2}{2kg} \times \frac{l^2}{12r^2}}$

This table not only shows the comparison of the two types of spring mounting but it also points out that a given spring mounting may be good for forces of a given frequency and no good for moments of the same frequency. It all depends on the ratios R/r and $1/12 \times l^2/r$. In spring mounting unbalanced machines and reciprocating engines the same spring mountings must be good for both moments and forces which may occur. Here again the ingenuity of the designer is called into play.

Detailed discussion of spring mounting for elevator motor generator sets, refrigerator motors, single phase electric machinery, internal combustion engines and ship drives will be discussed in a following article.

THE American Society for Testing Materials has issued the 1931 supplement to its 1930 *Book of Standards*. The latter is published only every third year, and standards which are adopted by the society in the intervening years are issued in supplement form.

The 1931 supplement is a pamphlet of 144 pages, containing 32 standards adopted or revised by the society on Sept. 1. Seventeen of the standards are new, and 15 are replacements of existing standards. The society now has 443 standards in effect, all of which are listed in the supplement.

**Influence of Damping in the Elastic Mounting of Vibrating Machines*—Applied Mech. Div., A. S. M. E., 1931.

Friction Clutch Is Improved by Oil Cooling

By H. F. Shepherd

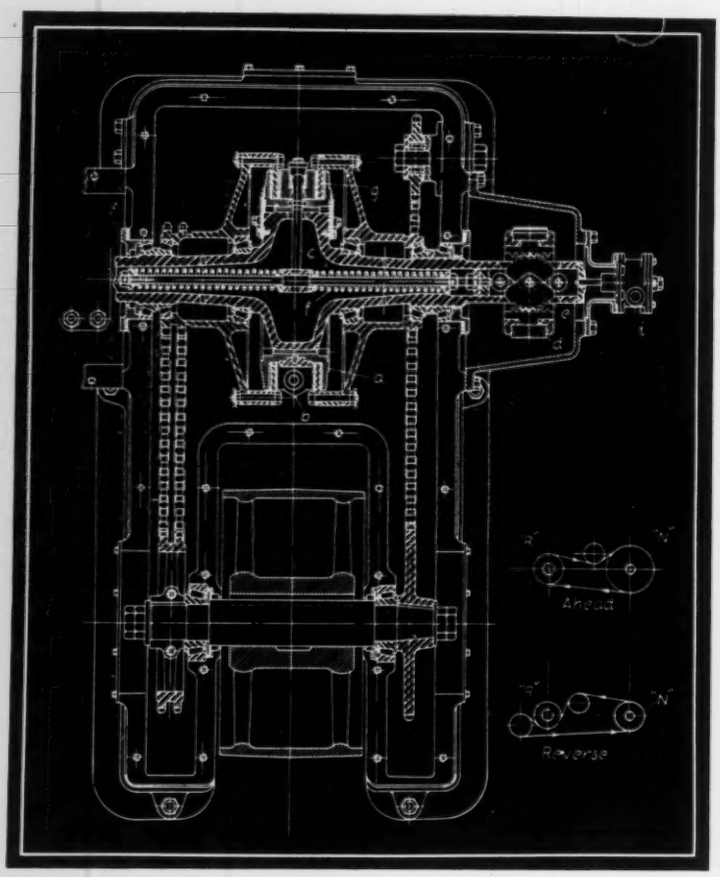


Fig. 1—Pinch bars c serve to move friction facings in opposite directions on both sides of the friction rings

INCREASED use of gas and diesel engines for oil well drilling has resulted from the growing employment of natural gas in some localities and the scarcity or impurity of boiler water in others. These prime movers, however, cannot be started and maneuvered smoothly under heavy loads. They therefore are allowed to run continuously in one direction and friction clutches are used to give ahead motion to the drilling and hoisting machinery; any one of the better known reversing transmissions is made to intervene when back motion is needed.

Internal combustion engines used for drilling are capable of meeting a load with kinetic energy alone momentarily equal to their normal full load torque. The clutch engages this combined power and momentum with the great mass load in the derrick. It functions not only to apply power, but in order to avoid destructive shock must slip until the load is accelerated fully. Often it acts as a brake to absorb the energy of the moving rig machinery during reversal.

Every known type or style of dry friction clutch has been used for this work. Some have been successful, particularly those on cable tool rigs which use only 100 to 150 horsepower at the most. In rotary rigs handling loads of 75 tons or more and using 300 to 600 horsepower unusual measures are required.

In either type of rig the clutches are called upon to function a hundred to a thousand times at intervals of from one to three minutes. Under these circumstances it is apparent that cooling and the avoidance of abrasion of both linings and metal faces are major problems in design.

The conductivity of the cast iron disks or drums is small. That of the asbestos linings is of no utility whatever. Consequently heat radiation is poor. Some attempts have been made to cast a fan runner in clutch members to aid in cooling. This is effective in open mechanisms but not applicable to the more desirable and more modern enclosed ones. Cooling the clutches and distributing their heat by a flood of oil therefore was suggested as a means of improving life and operation.

Failure Predicted for Previous Lining

In developing the type of clutch necesary a precedent existed for the use of asbestos friction facings in operating oil, in a successful crane load brake application. This combination was attempted. Prophecies of failure were numerous, however, ranging from predictions of disastrous explosions to utter failure of the friction.

The single disk with two friction facings seemed most desirable, and linings that would neither disintegrate nor lose their grip in oil

were sought. A number were tried some of which were frank failures. Woven linings impregnated with a drying oil which is not soluble in petroleum were as good if not better than pulp blocks well reinforced with wire and so vulcanized as to be oil resisting. The rubbery folded and frictioned materials were palpable failures due to dissolution of the bond and their low coefficient of friction when in oil. Seemingly success lay not so much in the method of building the lining as in the manner of bonding the asbestos finally chosen.

Positive Release Is Provided

Construction of the dual clutch developed is shown in Fig. 1. The U-section friction ring *a* is slidable in the hub, and the inner friction ring *b* is free to move on *a*. Pinch bars *c* having a floating fulcrum on ring *a*, when actuated by shift collar *d*, cams *e* and draw bar *f*, shift *a* and *b* in opposite directions engaging one disk *g* on both sides and positively releasing the other. Reverse is effected by the method of wrapping the chain on the sprockets as shown in the drawing. Patents are pending on this mechanism.

With suitable facings oil cooled clutches show remarkable properties. Time is required to squeeze the oil out although almost inappreciable. The building up of the coefficient of friction to the value required for engagement is graduated with the result that the kinetic energy of the revolving parts is braked, reversal takes place and the system is accelerated to full velocity in the contrary direction without shock. The intense local heating of the friction surfaces is eliminated and there is no roughening or scoring of the metal faces. Wear of the asbestos facings is greatly reduced.

The clutch should not run in oil literally as churning sets up heat and the oil does not cover the friction surfaces due to being kept out by centrifugal force. To be effective oil must be introduced near the center as through a hollow shaft (see pump *i* and shaft in Fig. 1) flowing outward between the disks under the influence of centrifugal force and being recirculated through a strainer or filter. A cooler may be used to dissipate the heat in large installations but usually the distribution of the heat into a large volume of oil which is thrown against the large radiation surface of the casings equalizes and radiates heat keeping oil temperature moderate.

A wide range of clutch design factors has been used in this work. A clutch based on 15 pounds per square inch disk loading with a coefficient of friction of .30 and a ratio of 2 to 1 between clutch slip torque and mean rated engine torque gave outstanding service. The disks showed no appreciable wear and the duty of holding a strain on a wire line while slipping the clutch continuously failed to overheat it.

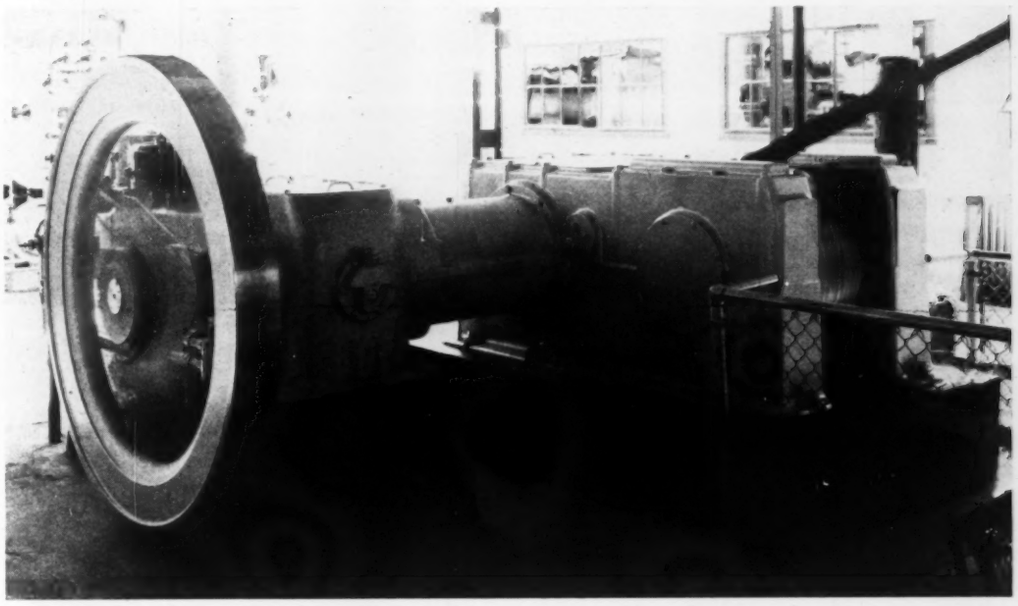


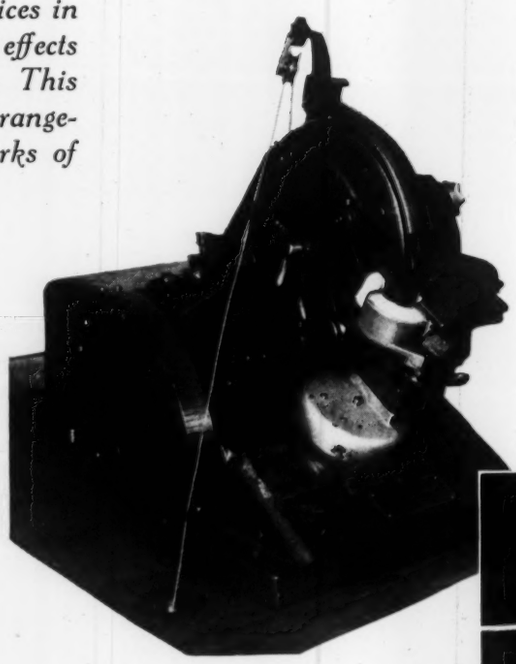
Fig. 2—Oil well drilling rig drive equipped with reversing clutch cooled by oil

A limiting case is an internal expanding clutch used with a rotary rig which was loaded to 120 pounds per square inch with a coefficient of .30. Wear of the shoes was so much as to require daily adjustment but the clutch continued to function.

It would seem safe to predict that oil cooled and lubricated clutches can be worked continuously at 30 to 45 pounds per square inch unit facing pressure with a coefficient of .30 which is far more than dry plate clutches have withstood creditably in this type of service.

Overcoming Variable Velocity to Permit Increase in Speed

DANCER rolls in the textile field, gravity rolls in wrapping machinery, spring take-ups and retarding devices in other industries are used to combat effects of varying velocity of material. This article describes an ingenious arrangement developed at Hawthorne works of Western Electric Co. Inc.



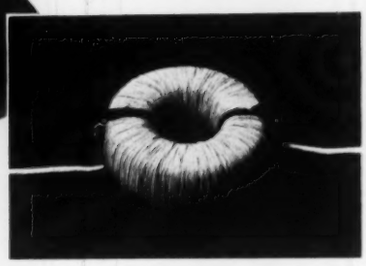


Fig. 1—Toroidal coil winding machine. Only upper part is shown. Fig. 2—(Below)—Completed coil

By Henry M. Larsen

FROM a design standpoint, the problem of winding toroidal coils consists principally of ability to wind the coils at high speeds without breaking the wire. Machines for winding these coils require special spring mechanisms in the winding ring to absorb the uneven stresses in the wire. As toroidal coils form closed circles it is, of course, necessary that the wire be wound around the core rather than rotating the core to receive the wire as with the conventional open end coils.

Winding wire about a closed core by machine causes an eccentric arrangement to exist between the winding rings of the machine and the core, as shown diagrammatically in Fig. 3. During the rotation from about 0 to 90 degrees it can be seen that there is a rapid demand for wire; from 90 to 180 degrees there is a lesser demand; and from 180 degrees to 270 and to 0 there is more wire off the shuttle than is needed for the remaining half turn of wire about the core. To make a machine which will satisfy the sudden demand for wire from the shuttle, and the handling of the excess wire, constitutes the major problem of winding the coils at high speeds.

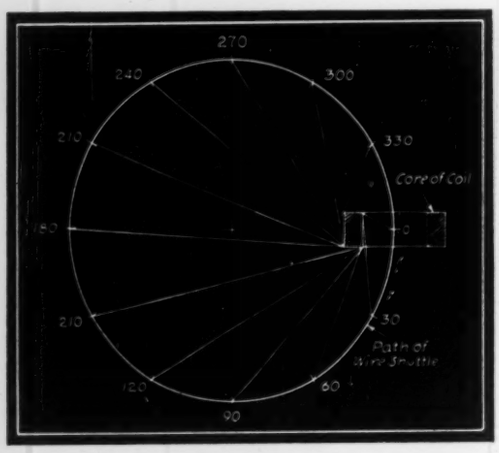


Fig. 3—Eccentric arrangement of core and winding rings, showing wire at various degrees of rotation

The machine in Fig. 1 is used for winding the toroidal coils. Of the two rings which thread through the core, the one on the left is the shuttle which is loaded at the start of the operation and thus contains the wire to be wound subsequently on the core, and the one on the right is the power driven gear ring. An enlarged diagram of the relationship between the shuttle and gear ring is shown in Fig. 5.

In operation, after an amount of wire sufficient for winding a complete section of the coil is wound on the shuttle, the end of the wire is strung over the sheaves in the power driven gear ring, and thence to the core. The shuttle is propelled only by the pull of the wire, a slight

tension being produced by a brake on the inner periphery of the shuttle to prevent it from overrunning and to cause a firm winding of the coil. While operating, any cause for increase in rotational velocity of the mass comprising the complete shuttle increases the tension in the wire and this tension may be great enough to break the wire.

Consequently, under ordinary conditions a given machine is limited in speed by the strength of the wire. For example, at 600 revolutions per minute it is found that a loaded shuttle weighing 1.36 pounds must accelerate an instantaneous maximum of about 5673 feet per second, and the force necessary to do this is 240 pounds. This far exceeds the breaking strength of 16 pounds for annealed 22 gage copper wire. It is evident that the machine either must be reduced in speed or some change in design be made to reduce the stress.

To attain the desired speed of 600 revolutions per minute without causing the wire to break, a gear ring was designed as shown in Fig. 4.

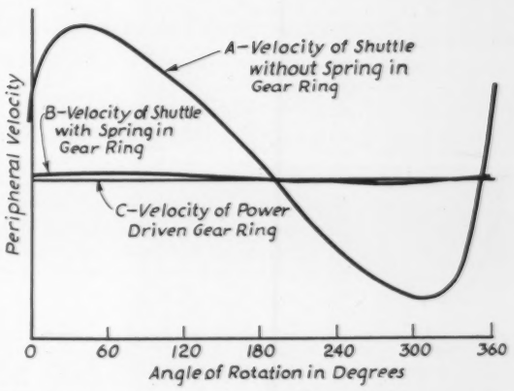
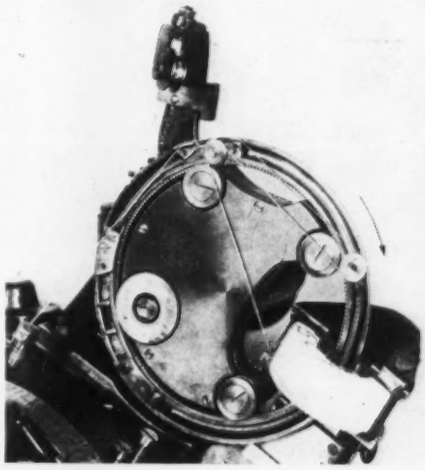


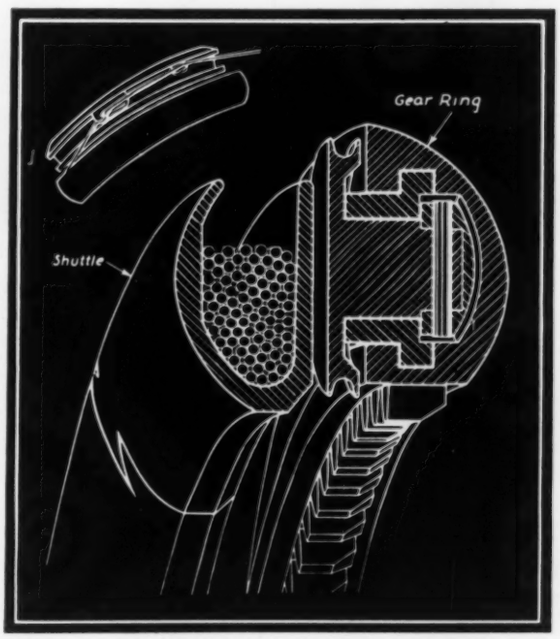
Fig. 6—Velocity curves, shuttle and gear ring

Instead of supporting the axis of both sheaves rigidly, one sheave was made movable by mounting it on a crosshead slider and supporting it flexibly in its movement in the gear ring by a long tension spring. It can be seen that during the first half of a revolution when the gear ring is demanding a transient removal of wire from the shuttle, the spring responds in the proportion of the mass of the shuttle to one-half the mass of the moving parts within the gear ring.

This proportion of mass is found by calculation to be 40 to 1, respectively, and so instead of creating a breaking force as in the springless gear ring of 240 pounds. the force acting upon the wire to accelerate the mass comprising the shuttle, adjacent to a spring equipped gearing, is but 1/40 of this force, or about 6 pounds at the point of maximum stress. This reduced stress is acceptable for 22 gage wire under normal shop conditions.

Fig. 4—(Right)—Spring arrangement and method of stringing up the gear ring. Fig. 5—(Below)—Diagram of shuttle and gear ring. Sheave and slider are seen in position in ring. Insert shows the two shoes over which wire passes in leaving sheave





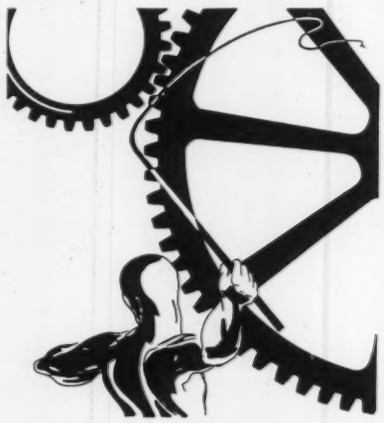
The curves shown in Fig. 6 depict clearly the relative instantaneous velocity of the shuttle with respect to its adjacent power driven gear ring, curve *C*; shuttle and gear ring operating under the unfavorable condition of a ring not equipped with the spring mechanism, curve *A*; and alternatively with the spring mechanism in the gear ring, curve *B*.

Equations can be set up to express the relationships of the length of wire demanded from the shuttle, the velocity and the acceleration of the shuttle under the condition of no spring in the gear ring. It is not proposed to outline the analysis in this article however, inasmuch as readers probably will be more interested in the ideas embodied in the machine than in intimate details of the computations necessary in designing it.

Putting the Whip to Work

Review of Ralph E. Flander's Book, "Taming Our Machines," by Harold B. Veith

STALKING across the horizon of the depression appears a mechanized specter—that is the picture projected frequently in countless discussions both written and declamatory which have arisen from the present industrial recession. Some attempt has been made to leave the impression that the machine is an ogre, and it remained for Ralph E. Flanders to champion its cause in his new book, "Taming Our Machines." He states that there is no inherent devil in the machine and that there has been no important failure of machines or of man the engineer in the technical designing and development of them.



After a brief review of history, Mr. Flanders takes the reader to such a year as 1929 when the country knew no depression. Circulation of goods, services, credit and money is at the height of activity with industry's wheels turning day and night. There is breadth and sweep of life; but unfortunately, with all our improved mechanism of production and distribution we have not been able to solves the problem of maintaining this eddying, re-entrant and regenerating flow of commodities, money and credit. And in the world's present state of flux critics look askance at the machine as a complimentary cause of the trouble.

These men point to the "good old days" with a feeling of nostalgia. It is these individuals who should read the convincing argument in "Taming Our Machines." The modern conveniences which have been the direct result of mechanization are pointed out admirably by Mr. Flanders, but he has not ignored the difficulties that have been brought about by the rapid development of our mechanical civilization. He strikes a keynote, however, when he declares that the real problem is in the heart of our economic system in the daily operations of producing, distributing and consuming wealth.

Among sound thinking men it will be found that their contentions generally agree with Mr. Flanders when he says that the records of the engineer and his product are clear. It is the faulty use of our machines and our maladaptations to their economy that deserve the blame. Our general problem at this point lies with the difficult field of economics, he says. Devoting a full chapter to economic proposals, the author-engineer outlines a suggested line of attack by an authoritative body properly organized and adequately financed for the purpose.

Each member in charge of a particular phase of the investigation would report at a hearing the purpose of which, Mr. Flanders brings out, would be to fathom each viewpoint in its relation to (a) the different phases of the business cycle, (b) the various elements of the social mechanism — farming, transportation, manufacture, selling, etc., (c) the responsibilities of individuals, business, banking and the government, (d) the reactions between each item and the other proposals and viewpoints and, finally (e) the probable effect on the stabilization of business and the raising of the standard of living.

In discussing the subject of specialization, Mr. Flanders relates that it began to be observed a few years ago that the student who had narrowly specialized in one subject usually found his final life work in some quite other line. Reading the omens of statistics educators have wisely limited the opportunities for specialization in undergraduate years and the young engineer now is provided with a sound and extensive basis of technical knowledge. We need not be seriously concerned with this aspect of technological tenuousness, he declares.

After reading "Taming Our Machines" the reader is impressed that the sheer wielding of the whip of criticism will not bring our mechanisms into line, but instead it will be the thoughtful and determined reining of the inanimate servants with a systematic economic program. There is a great deal of satisfaction in reading what an engineers sees is this phantasmagoria.

The book may be obtained from Richard R. Smith Inc., New York, the publisher, or from MACHINE DESIGN for $2.50 plus postage.

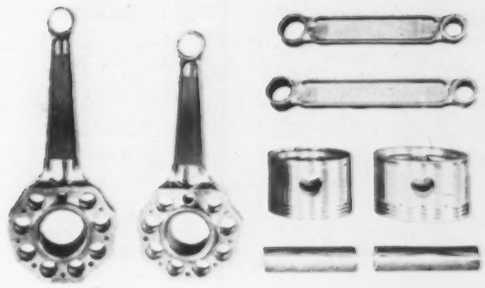


Fig. 1—Same piston pins, bushings, etc. are used in each engine

Utilizing Existing Parts in New Models

By V. I. Moncrief

NEW models are costly—often more so than the prospective market warrants. But where the new machine varies principally in size or capacity and is not a distinct departure in design, tremendous economies can be effected by utilizing as far as practicable the parts already developed for existing models.

WHEN the now famous "Wasp Junior" engine was put into production, it was announced that approximately 75 per cent of its parts were from previous designs. This fact has attracted so much attention that an analysis of the design of this engine may be of value in stimulating interest in design standardization.

The function of engineering is to create. Standardization aims at the use of existing parts wherever possible. The two are apparently in opposition—but so are electric current and electrical resistance. Both are essential. Changes will be made in design as long as experience and research point out ways for improvement of product. Changes are the arch enemy of standardization, but there is no need to allow them to run wild. Standardization can have its innings if the person who O. K.'s changes regards these proposals with a cold and skeptical eye until their value is made evident to his satisfaction. Standardization and change for improvement of product are both essential, and only good judgment will properly evaluate these two complementary but conflicting factors. This conflict is especially evident in the youthful aviation industry—yet the "Wasp Junior" engine is a good example of what can be accomplished in standardization around a basically good design.

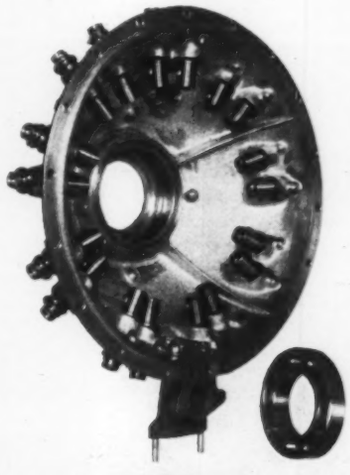


Fig. 2 — Though the nose is not interchangeable on each model, the same tappets, tappet cups, thrust bearings and other parts can be used

All Pratt and Whitney engines are nine-cylinder radial, air cooled differing in bore and stroke. For analysis the engine may be considered as a power section plus a rear (accessory) section.

The power section contains a single throw two-piece crankshaft mounted on two roller bearings set one each in the front and rear main case halves, of forged dural, which are bolted together at nine points between the nine holes on the periphery in which the cylinders are set. On the single crankpin is the master rod in whose big end twin flanges are eight knuckle

pins to take the lower ends of link rods. Pistons, rings, cylinder barrels and heads are more or less conventional. Valves in cylinder head are actuated by enclosed push rods through ball bearing rocker arms. Immediately forward of the power section, but really part thereof, is the nose section enclosing oil bracket to deliver oil to hollow crankshaft; the cam with its train of four gears; and containing the roller tappets which actuate push rods, and the thrust ball bearing in tip of nose.

Many of the power section components defy standardization. The 985 cubic inch Junior of 5-3/16-inch bore x 5-3/16-inch stroke cannot reasonably be expected to use the crankshaft and connecting rods from the 1340 cubic inch Wasp of 5-3/4-inch bore x 5-3/4-inch stroke, because of excess weight and other reasons. Riveted-on counterweights on crankshaft balance the

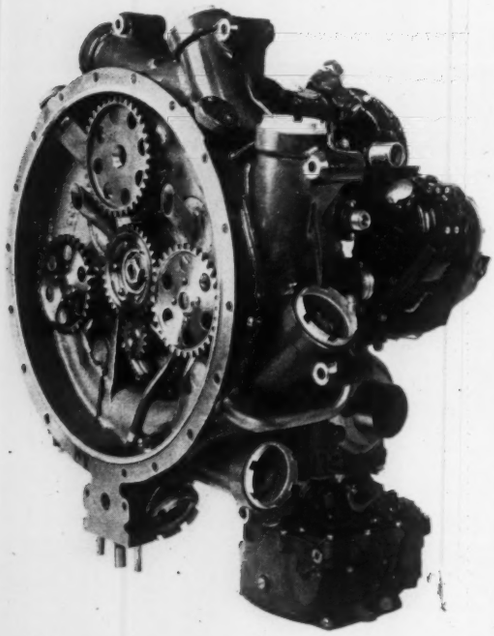


Fig. 3.—Standardization is comparatively simple on the engine rear section

weight of rods and pistons. If these parts are needlessly heavy excess counterweight is required so there is a double penalty for unfortunate design here.

Since the power section parts are harder to standardize than those of the rear section, an analysis covering some of the power section components is given in the table, with terse reasons for dissimilarity between Wasp and Junior.

Fig. 3 shows a completely assembled rear section while its inner mechanism shows clearly on left half of Fig. 5. In this assembly are two nine-cylinder magnetos (to provide two sparks to each cylinder), starter (clutches into shaft of upper gear), blower drive, oil pump (bottom of right side vertical shaft), fuel pump (bottom of left side vertical shaft), two tachometer drives (off spiral gears on vertical shafts) and two gun synchronizers (off top bevel gears on vertical shafts) for military engines. A generator drive also can be furnished, when desired, which meshes into bevel gear on starter shaft. Fig. 3 shows the carburetor and oil regulator immediately above it, to cool engine oil and heat carbureted mixture before entry to impeller.

Drives Have Unvarying Ratio

With one exception, none of these drives ever vary in ratio or in the slightest detail. The single exception is the blower drive where a number of ratios from 7:1 to 14:1 can be supplied, the ratio being determined more by purpose for which engine is intended than by engine size. Three of the four blower gears change in making ratio changes.

Engine displacement and horsepower make no difference in accessory drives. Power to drive nine-cylinder magnetos for example, depends only on speed. Heavy blower ratios require more power but the substituting gears provided are proportioned accordingly. Two sizes of inertia starters cover all requirements from the largest to the smallest engines. These are interchangeable in mounting and can be changed over in a few minutes.

There are a few differences in the Wasp and Junior rear sections, in addition to the above op-

Analysis of Engine Parts

Part	Shown in Fig.	Jr. same as Wasp	Reason for Dissimilarity
Crankshaft	5—Rt. center	No	Weight and stroke
Counterweights	5—Lower Rt.	No	Weight to balance
Crank roller brgs.	5—Rt. center	Yes	.....
Crank rear gear	5—Center	Yes	.....
Clutch 13 parts	Inside gear	Yes	.....
Misc. cam parts	.....	Yes	.....
Front main case	.....	No	Smaller engine
Rear main case	.....	No	Smaller engine
Cylinder stud	.....	Yes	.....
Studs, nuts, washers, etc.	.....	Yes	.....
Rod upper bush	1	Yes	.....
Rod lower bush	1	Yes	.....
Knuckle pins	.....	No	Lighter rod flanges
Pistons	1	No	Different bore
Spark plug bushing	4	Yes	.....
Rocker shaft inserts	4	Yes	.....
Outer valve sprg.	4	Yes	.....
Valve locks	.....	Yes	.....
Rocker arms	4	Yes	.....
Rocker bearings	4—In rockers	Yes	.....
Intake pipe	.....	No	Shorter, smaller
Intake wire clips	.....	Yes	.....
Push rod ball	.....	Yes	.....
Thrust bearing	2	Yes	.....
Tappet guides	2	No	Different bosses
Tappet roller	2	Yes	.....
Breather cap	3	Yes	.....

tionals. The blower housing differs due to necessity for making a different hook-up for the pressure oil to the power section cases, which are

much smaller overall in the Junior. The packing nuts where intake pipes enter blower are smaller. Several external oil pipes are different. Carburetor is single instead of dual and has a different mounting flange so oil regulator body is different also. All other parts are identical in both engines.

A summary of the differences shows that 33 of the 100 parts comprising the power section

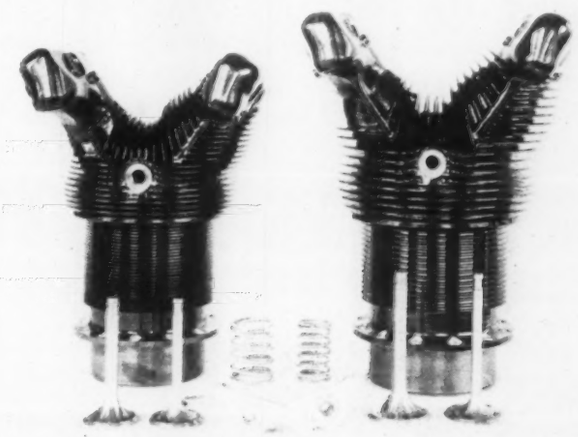


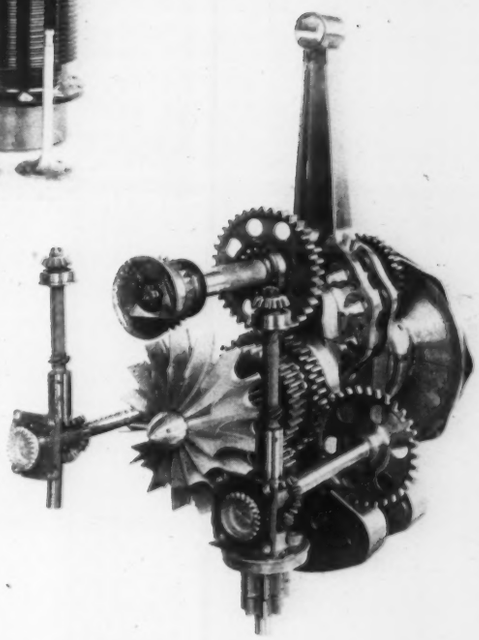
Fig. 4—Comparison of cylinder units used on each size of engine Such parts as valve springs, washers, rocker arms, rocker bearings, plug bushings, etc. are similar

are not the same on both engines. While no detailed tabulation has been made of the rear section parts, it is estimated conservatively that 95 per cent are common to both engines. The total overall percentage of common parts thus figures out to 81 per cent which may not be exactly correct due to omission of numerous common small items such as bolts, etc. It is to be remembered that the comparisons are made in respect to one part of a kind per engine—if total number of pieces were considered the multitude of small common parts used would throw the whole picture out of focus, for after all we are looking upon number of kinds of parts and not number of pieces.

word for interchangeability which is a star near relative to standardization. The fact is standardization is not possible without interchangeability. Present day machine tools and measuring apparatus are so highly developed that there are few industries which now can afford to manufacture the old hand-fit way.

Standardization of materials is another interesting study. Experience has taught us the best

Fig. 5 — (Below)— Skeleton view of interior of engine showing supercharger impellor in center



Standardization Brings Cost Reduction

Reduction of cost is the sole purpose of standardization. Some of these savings are direct savings in the manufacturing plant; others are secondary savings in the cost of raw or finished purchased parts, or in the lessened inventory expense at the factory or the service stations throughout the country. It is known that the smallest manufacturing and service inventory consistent with proper conduct of business marks a high achievement in industrial efficiency. All other arguments for standardization in design are more or less unnecessary.

The direct savings at the factory are effected through concentration of labor on fewer parts, longer "runs" in the shop, greater opportunity for tooling up, less likelihood of manufacturing and stock room errors, etc.

It may not be out of place here to say a good

steels, bronzes, aluminums and miscellaneous materials to use for given parts. For the most part these materials are S. A. E. standards. The exact nature of the material and its heat treatment and properties are as much a part of the drawing for a piece as its size and shape.

The business of design standardization is just plain hard work and requires determination and follow-through to put across, with a dash of imagination to touch it off. On new designs the engineering department should consult freely with members of the manufacturing department, who often have good ideas and can point out things which would have to be changed when part gets into production. If few design changes require to be made after issue that design will show a better score for standardization than one which develops a noticeable change history. In this same direction it will be found that good, straightforward design usually is best and that

tricky stuff, uncertain fastenings and dependence on providence to make things work usually results in redesign—another set back for standardization.

When proposals for change come up they can be classified as to whether or not they affect interchangeability. If they do they must be fought off unless they actually are necessary. If they do not affect interchangeability they may be approved if they show sufficient promise for shop savings, improved product, etc.

Most readers will acknowledge that there is something to the standardization idea. To those who believe not or who believe but do nothing, it is earnestly suggested that it be given a fair trial. There are possibilities enough in it to fill a book. After standardizing the small parts thoroughly the larger parts can be undertaken. Drawing files should be checked and notes made of the number of parts that are similar. Minor differences may be reconciled and a compromise effected and kept in mind for future new design.

Photoelasticity Assumes Prominent Place in Stress Determination

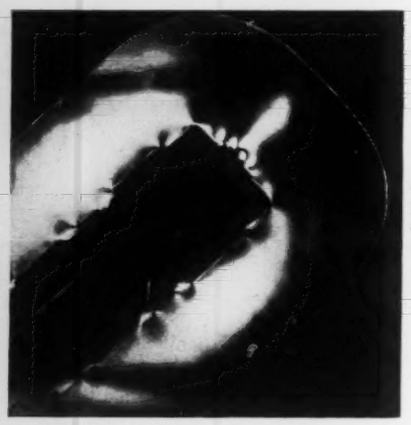


Fig. 1 — Photoelastic picture of model of sheet mill housing showing regions of maximum stress

ONE of the most important of the recently introduced processes affecting design is photoelastic observation of stresses in machine parts. Examination by this method may reveal dangerous stress concentrations which often can be remedied by redesign of the part. An instance of this, the frame of a punch press advantageously redesigned following photoelastic observation, was cited by Everett Chapman, Lukenweld Inc., Coatesville, Pa., in a paper presented before the American Welding society meeting held recently in Boston.

In another paper presented at the meeting, Wilmer E. Stine, Lincoln Electric Co., Cleveland, brought out the factors in the production of steel which govern the qualities of welds made with that steel. The investigation was made with steels produced by several different makers.

Mr. Chapman stated, in part, that there are "sore spots" in every structure which constitute the burden of every engineer's responsibility. It is within these localized areas that designers must look for the reasons behind the factors of safety, unit cost and insidious fatigue failure; insidious because it may terminate the useful life of the machine in 1, 3 or 15 years.

An illustration of the differences that may be effected in a structure by slight changes in contour is afforded in Figs. 2 and 3. It is to be noted in this photoelastic picture of the conventional type of C-frame punch press that there are two serious stress concentrations in the structure as it has always been designed.

Rough measurements of stress at these changes of contour give stress ratios of 12:1 and 8:1, respectively. The remedy for this structural discrepancy is decidedly not to increase the metal section back of the throat. Using a modified contour, Fig. 3, the stress ratios within the structure can be reduced to a spread of the order of 3 to 1. It is to be noted that this change in contour and the resulting reduction in maximum stress has been effected by removing metal from the original. In the design of this particular press a stress ratio of 3 to 1 would be economical for the class of material used and accordingly the first press was built, designed from photoelastic data, to take a 25-ton load. After completing the frame a hydraulic jack was placed between the platen and the main bearings and the frame subjected to incremental static loads up to 50 tons. Strain gages placed at the critical point, indicated in the photoelastic study, gave readings from which the stress-load curve could be plotted. The strain gages checked the predicted stresses as calculated from the photoelastic measurements. After obtaining the stress-load curve, the endurance limit for the

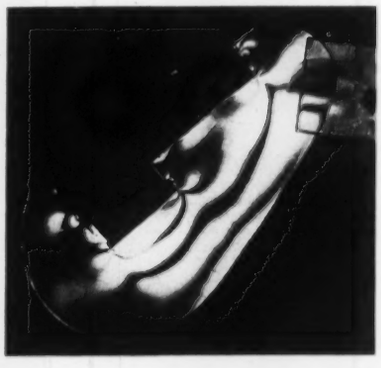


Fig. 2 — Conventional press frame contour showing two severe stress concentrations

class of material used in the construction of this frame was spotted on the curve and the corresponding safe load noted.

Ductile metal in a weld fillet is basically important, according to Mr. Chapman. The modern welding processes will deposit a metal having a high degree of ductility, but that is not enough. The parent metal alongside the weld generally is overheated and in cases where the carbon content is too high it will show a sorbitic structure that is more brittle than the annealed parent metal. It therefore is necessary, in dynamically loaded structures, to anneal the piece thoroughly after welding to restore the ductile characteristics of the metal round the weld. If this is not done, uniform performance of the structure as a whole cannot be predicted.

Study Steels Used in Welding

Most welding engineers have had at some time or other welds made that were not all that could be desired, according to Mr. Stine. The technique had seemed perfect, proper currents and equipment had been used and yet porosity had resulted. It was in an endeavor to eliminate this that a study of the relations of the chemical constituents of steel was made.

Defects that may develop because of certain characteristics of the steel forming the weld are: cracks, slag holes and gas holes. This investigation is confined largely to the causes of the latter two classes of defects.

Gas holes are not formed to any appreciable extent where the arc is in an oxidizing atmosphere. The weld metal in such cases is overoxidized, has little ductility and will not be a high quality weld. High quality arc welds can be made only with a shielded arc. Gas holes become an important factor in such welds.

Fig. 3 — Modified contour of press frame showing relief of the highly stressed areas of Fig. 2

It was found that steel which formed slag holes in the weld invariably had been aluminum killed and contained an appreciable amount of Al_2O_3. This characteristic was checked by covering a piece of good welding steel with a thin layer of Al_2O_3 before welding it. In order to determine whether this characteristic is a matter of melting temperature of the inclusions, a similar test was made with chromite, which has about the same melting temperature. The result was almost identical.

It is evident that slag holes or depressions are caused by nonmetallic inclusions in the steel which remain as finely divided solid inclusions during the steel making process, but during the arc welding process melt and coalesce to form large globules which solidify ahead of the steel and form holes or pits in the weld metal. These holes can be eliminated by using a slag forming flux of low melting temperature which will combine with slag of the steel forming a new slag having its melting temperature below that of the steel.

Results of Tests on Several Sample Steels

Sample No.	101	1020	1021	1015	1016	1045	1050
Furnace	O.H.	O.H.	O.H.	O.H.	O.H.	O.H.	O.H.
Recarbonized	Yes	Yes	Yes	No	No	Yes	Yes
Deoxidizer Furnace	.....	.....	.....	Spg.	Spg.	.....	.....
Deoxidizer Ladle	Mn	Mn	Mn,Si	Mn	Mn	Mn	Mn,Si
Deoxidizer Mould	No	No	Al	Al	No	.....	No
Aluminum oz./ton	0	0	1.5	.....	0	.....	0
Analysis C	0.20	0.19	0.21	0.14	0.14	0.48	0.51
Analysis Mn	0.44	0.60	0.52	0.75	0.75	0.74	0.59
Analysis S	0.029	0.027	0.034	0.111	0.111	.....	0.035
Analysis P	0.016	0.018	0.020	0.016	0.016	.....	0.025
Analysis Si	0.02	0.02	0.07	0.012	0.012	0.20	0.08
Analysis Cu	0.03	.....	.....	.....	.....	.....	.....
Analysis Al	.....	.....	0.005	0.116	0.014	.....	.....
Analysis Ni	0.02	.....	.....	.....	.....	.....	.....
Size—Thickness	⅜	⅜	½	⅜	⅜	⅜	⅜
Welding Amps.	300	300	300	300	300	300	300
Welding Volts	38	38	38	38	38	38	38
Welding speed in./min.	15	15	15	15	15	15	15
Porosity	0	1-2	3	4-5	1-2	5	1
Appearance	Good	Good	Good	Poor	Good	Poor	Good

If the capacity of the steel for holding gases in solution is to be maintained at a value equal to what it was in the ingot molds, the aluminum, silicon or manganese must not be oxidized out during welding to any appreciable extent. In order to prevent the rapid absorption of gases at the high welding temperatures the content of these elements should be as low as practicable. The oxidation of carbon during welding is permissible, but this reaction should cease before solidification of the weld metal begins.

Chemical equilibrium should be reached between the carbon and the oxygen in the steel at a temperature slightly above the temperature of solidification, and at least one deoxidizing element (aluminum, silicon or manganese) should be present in an amount which also will be in approximate chemical equilibrium with the oxygen present in the steel at a temperature slightly above the temperature of solidification.

Under this ideal condition a steel of given carbon content will have a minimum capacity for absorbing gases at the high welding temperature. Its capacity will increase as the carbon is oxidized out. The formation of carbon monoxide will cease before the metal solidifies and there will be a minimum change in the amount of gas solvent elements such as manganese, silicon or aluminum. Such a steel therefore, should have the best arc welding characteristics.

Steel Balls as Machine Parts Simplify Design

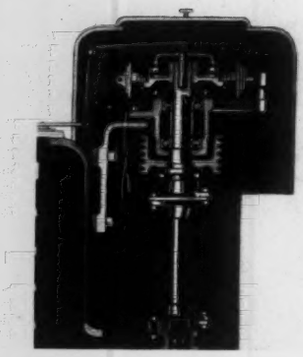


Fig. 1—Steel balls actuated by centrifugal force function as safety lock

By Allen F. Clark

Editorial Representative, Machine Design

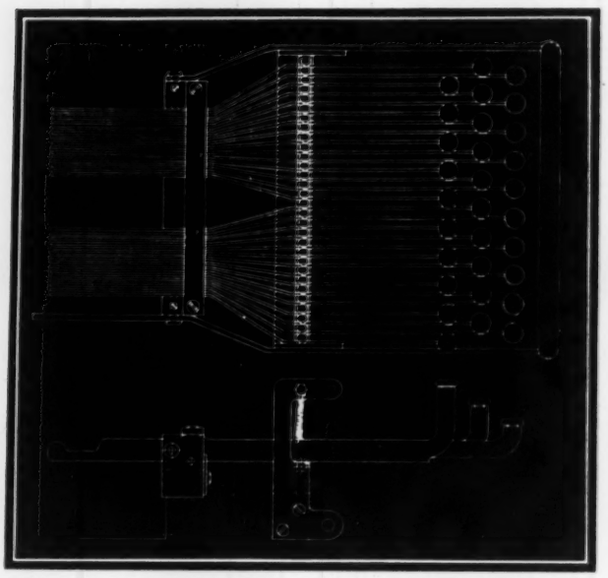


Fig. 2—Only one key of this keyboard can be depressed at a time

SUCCESSFUL adaptation of materials, parts and mechanisms to uses outside their usual field often marks the difference between outstanding and mediocre design. It is the knack of applying known properties to new uses that marks the successful designer.

A part that has been known and studied for years and yet has not found widespread application is the steel ball. The average engineer will include in the uses of this unit the ball mill, thrust applications, ink grinders, valves and the like and then will be hard put to recall another application. Yet "nothing rolls like a ball" and a number of designers have adapted this and other qualities in steel balls to praiseworthy mechanical uses.

Adapted to Machine Control

A simple and effective method of controlling the operation of a machine so that there will be no jamming of parts is accomplished with steel balls on the Compotype manufactured by American Multigraph Co. This machine, operated by a keyboard, makes printing type from an aluminum ribbon fed through automatically. It was necessary to provide means to prevent the operator from depressing more than one keybar at a time. This was accomplished by placing a row of steel balls equal in diameter to the center to center distance of the keybars, in a suitable retainer or ball race, just below the keybars, Fig. 2. There is one ball for each keybar, and the ball retainer, closed at each end, is of such length as to permit one keybar only passing down between any two balls. No other keybar can be depressed until the first one has come up from between the balls. This apparatus does not slow up the key action in the slightest, and has proved of great value.

The "eagerness" of steel balls to roll also is applied in the equipment manufactured by Cleveland Folding Machine. In the folding machine, a portion of which is shown in Fig. 3, the paper, after having passed through the first folding operation must be turned 90 degrees to pass through the second operation. The paper travels lengthwise of the rolls until it is clear of the tapes removing it from the folding mechanism. The rolls, set at an angle, then force it against the guide and out at the right.

It was necessary that there be some method of holding the paper against these rolls without retarding its progress, and without crumpling it. Steel balls placed over each roll effectively hold the paper so that the rolls can move it out against the pressure required to make the buckle fold. They receive their motion first from the rolls and then from the paper itself, giving a rolling, noninterfering weight. If less pressure is required, hollow steel balls, or glass balls may be used, while if the sheet be cut lengthwise with the rolls, during the first operation, and it is

necessary to retard the back portion to eliminate piling up, rubber balls placed over the rear rolls will slow this section sufficiently to allow the first section to clear the second folding operation before the second section enters.

A steel ball lends itself admirably to the application of force or redistribution of weight by centrifugal force. In a dynamic balancer for the elimination of vibration in motor rotors, two steel balls are held in place by a clutch. If the rotor speed is increased to a value somewhat above the resonant speed of the system and the balls are released in their race by depressing the clutch, since the shaft end carrying the head is whirling with its "light" side "out," the balls will roll in their race toward the "light side" or in such a direction as to decrease the resultant moment of unbalance of the system. The balls, therefore, move relative to their race in such a way as to counteract the effect of unbalance in the rotor. The clutch then can be engaged and the balls held in this position of equilibrium. With the position of the balls as they completely balance the system determined accurately, correction weights in the form of solder can be applied to the rotor to maintain this balance.

Develops Unbalance of Forces

The exact opposite of the principle given in the foregoing is used by Gifford-Wood Co. in the manufacture of Mitchell Vibrating Screens. In the vibrator for the screens, Fig. 4, an alternating current motor rotor is pressed on the shaft. The action of the vibrator is caused by steel balls in ball cages set at 180 degrees from one another at each end of the shaft. The vibrator is effected by two unbalanced centrifugal forces which are diametrically opposite. This causes the shaft to rotate about a common dead center on the babbitt bearings. To be less technical, the shaft wobbles about a certain point. This action moves the material on the screen attached to the vibrator upward and sideways simultaneously. The screen motion is an upward and downward circular motion with a sideways shifting motion occurring at the same time.

Steel balls actuated by centrifugal force also are effective as part of a safety device in a washing machine. The cover of the basket in the machine must be closed before power can be applied to the motor. The latch is connected by a rod, extending to the left in Fig. 1, to a bell crank which supports a cap-shaped casting. Below this cap are provided two inclined raceways attached to the brake drum and in these raceways two steel balls repose loosely. Since before the latch can be withdrawn the cap must be free to drop to the raceways, it is impossible to unlock the cover until the basket has come to a stop, since the balls are thrown out to the position shown and provide interference with the cap's movement. The result is a simple centrifugal governor safety device having no bearings or joints to stick and requiring no lubrication.

Ball Transfer Aids Handling

A recent use of these parts that has received considerable attention is the ball transfer developed by Mathews Conveyer Co. This transfer, Fig. 5 is made with a large hardened steel ball which rotates on a series of smaller balls held in a cupped base. Movement of heavy objects over a number of the transfers mounted on pipes or tables can be made with greatest ease in any direction without the necessity of overcoming friction or inertia such as that which might be present if casters were used.

A similar installation has been made by the company for ease in manipulating heavy cartons on the bed of a stitching machine, Fig 6. Here the larger ball is mounted on the smaller ones placed in cupped depressions drilled in the bed, with the whole installation enclosed in a housing.

A power transmission recently patented by Sperry Gyroscope Co. Inc., incorporates the principle of driving a member in either of two directions through a ball rotating continuously in one direction. In this unit, a drive shaft has a friction disk on the end which drives a ball, mounted in a retainer which forms part of an operating carriage. The disk is held against the ball by spring pressure. Two other friction disks inclined in opposite directions about 10 degrees

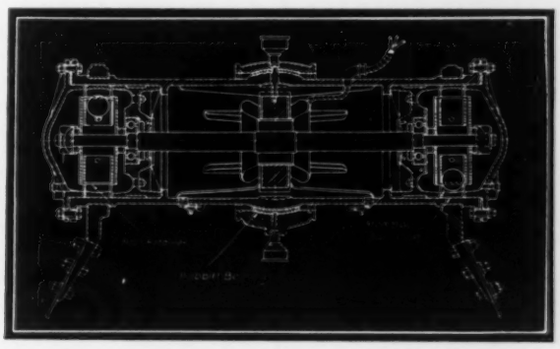
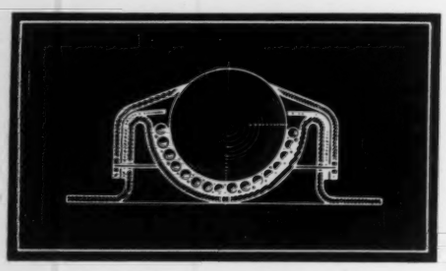


Fig. 3—(Left)—Rolling pressure is provided by balls on this folder. Fig. 4—(Above)—Unbalanced dynamic forces control vibrator movement

from the horizontal are mounted above the ball. They meet in skew gear teeth directly over the driving shaft and the driven shaft extends from one of them. When the ball is placed in contact with one of these disks through movement of the carriage, the driven shaft will move in one direction. When the ball is moved to contact with the second disk, the gearing will change the direction of driven shaft rotation without the necessity of changing the driving shaft rotation.

W. D. Root, Ohio Popcorn Co., has devised a



novel arrangement by which steel balls make an electrical contact for machine operation and control the time of this operation on an automatic popcorn machine. This machine employs a storage oven where the corn is kept in a plurality of charges ready to be served. This is necessary as it requires three minutes to properly pop corn. On the insertion of a coin popped corn is drawn out, and a ball is drawn from the upper supply glasses by the distributor which rotates slightly and passes the ball by gravity into contactor *D*, Fig. 7. One revolution of the commutator is a popping cycle.

After the commutator has started to revolve, current passes to the motor through the sliding contacts *A*. There is, however, an insulated spot on the commutator, *B*, which breaks the current when one of the contacts reaches this point. Contact *D* is connected into the circuit by the same connection as the sliding contact that is made inoperative by the insulated spot. The steel ball rolling through *D*, falls into the depressed portion of the commutator, *C*, and current passes through it to start the motor. After the commutator has revolved far enough to place both sliding contacts back into operation, the ball drops out, and the rotation continues until the insulated portion again comes under the contact. Inasmuch as corn is drawn out in 20 seconds and it requires three minutes to replace each charge, the balls must build up in the contactor if more than one sack is drawn out before the circuit is completed. If this happens, the balls wait their turn and each time the depression *C* comes around one more ball drops into it, completing the circuit, and continuing the operation until all the balls in the contactor are exhausted and the oven filled.

Safety in automatic machinery is provided by an automatic slip coupling, Fig. 8. The coupling, developed by American Machine & Foundry Co., operates through steel balls as they fit into grooves. A spring holds these balls in place, but as centrifugal force increases with running speed, the balls tend to move outwardly and any substantial overload will cause the coupling to slip, the balls moving out along the sloping sides of the grooves.

Included in the better known applications of steel balls is their use in sizing work where they have been particularly satisfactory. Where it

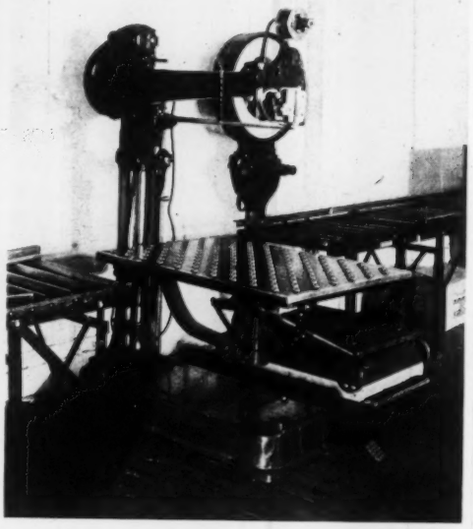
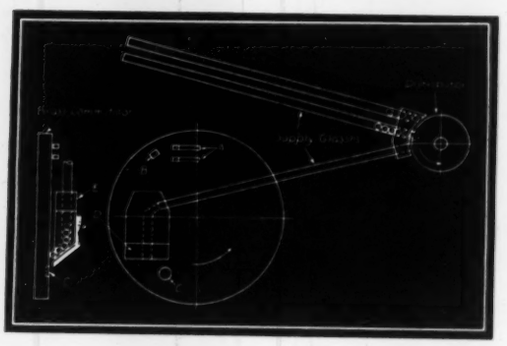


Fig. 5 — (Left) — Unique arrangement of steel balls simplifies movement of heavy objects. Fig. 6—(Center)—Ball transfers installed on the bed of a stitching machine. Fig. 7—(Below)—Effective control of time of motor operation is provided by the ball contacts



is necessary to have a fine finish in the hub of a wheel or gear and also close accuracy, it has been found that a ball pushed through the hole after drilling gives desirable results.

They also are used quite extensively in thrust applications. This installation is usually a single ball fitted into a "V" or center hole on the end of the shaft and resting against a flat hardened surface. An unusual variation of this consists in having a steel ball tightly fitted in the end of the shaft, this ball being in contact with another one located in a hardened and ground member. The recess for the lower ball when made slightly larger than the ball diameter will permit of this ball moving about constantly, bring new surfaces in contact.

Installations such as those presented in the foregoing should open for the progressive designer innumerable variations whereby the distinctive action of the steel ball can be made to perform some mechanical action easier, cheaper and with greater reliability.

The co-operation of the following companies

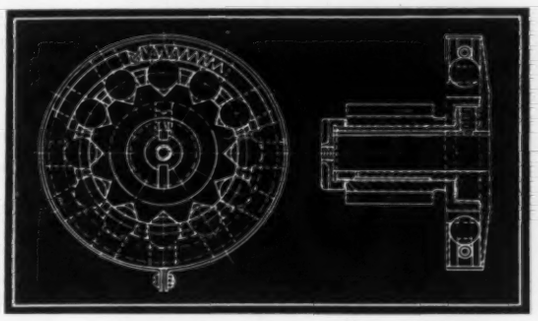


Fig. 8—Movement of steel balls controls operation of automatic slip coupling

in supplementing the material used as a basis for this article is gratefully acknowledged: Atlas Ball Co., Auburn Ball Bearing Co., Gurney Ball Bearing Co., and Norma-Hoffmann Bearings Corp.

Tip Relief Suggested as Improvement to Gear Tooth Form

PREMATURE engagement with its gouging action and delayed engagement with its scraping action may be prevented in gears by tip relief, a removal of material from the outer portion of the tooth profile. This was brought out by R. E. Peterson, manager, mechanics division, Westinghouse research laboratories, in a paper discussing the theoretical aspect of tip relief at the recent meeting of the American Gear Manufacturers association in Pittsburgh.

Augmenting the discussion of the subject, T. R. Rideout, Nuttall Works of the same company, presented a paper on the practical aspect, concurring that as the flank of the pinion tooth approaches the tip of the mating gear tooth, tip relief will delay engagement until the sharp corner of the tooth has passed the theoretical point of contact. With this provision gouging or scraping with resultant vibration, noise and wear, can be avoided, should the two involute curves not be exactly tangent to each other at that point.

Theoretically, Mr. Rideout declared, tip relief would not be necesary on accurate gears constructed of an inelastic material. In fact, the use of tip relief often is referred to as an error introduced to compensate for other errors in the gears themselves. Even if the involute curves were exactly tangent to each other at the point where contact nominally would occur first, there is a tendency for the sharp corner on the gear tooth to break the film of lubricant momentarily. Tip relief will remedy that condition to the extent of allowing a film of lubricant to be present on each side of the contact point.

The accompanying illustration shows a pair of teeth in contact under no load. If torque is applied to the pinion gear, the body of the pinion will advance, due to the deflection of the pinion tooth and its mating gear tooth; and the teeth will assume the positions as shown by the dotted lines in the sketch. The pinion tooth will deflect slightly more than the gear tooth for two reasons; first, the beam strength of a pinion tooth of conventional form as indicated by the Lewis *Y* factor is always less than that of the mating gear; second, the point of application of the load at the last position of contact, where only one pair of teeth is carrying the entire load, is further from the base of the pinion tooth than from the base of the gear tooth, with a corresponding greater bending moment. The diagram shows that the bending deflection of the teeth will make the base pitch of the pinion small and that of the gear large, with the resulting premature engagement or interference of the pair of teeth following those that were carrying the entire load, unless the tips of the teeth are relieved, as shown by the dotted lines, to eliminate the interference.

This deflection together with deformation due to elastic compression of the material at the point of contact occurs simultaneously, and the sum of the two is the actual amount of deformation. The deformation of the teeth varies with

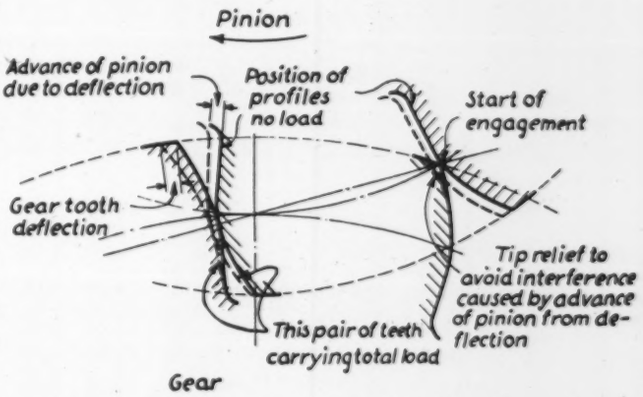

Pinion
Advance of pinion due to deflection
Position of profiles no load
Start of engagement
Gear tooth deflection
Tip relief to avoid interference caused by advance of pinion from deflection
This pair of teeth carrying total load
Gear

Diagram showing necessity for tip relief

the load, material, heat treatment, tooth form, and type of gear, and all of these factors must be considered in analyzing the deformation and in specifying the amount of relief necessary.

Under certain conditions, tip relief has serious disadvantages and the amount of relief therefore never should be any greater than that necessary to prevent interference.

Editorial

Obsolete Materials Are Detrimental to Performance of Machines

SO MUCH has been said and written about the obsolescence of machinery, equipment and methods that the industrial world has almost overlooked the fact that materials may become obsolete. It has remained for a mid-western steel company to emphasize in its advertising the staggering losses borne annually by manufacturers because they refuse to avail themselves of the opportunities offered by improved materials.

The central theme of this advertising appears in these sentences: "The annual waste involved in obsolete materials must mount into the millions. The depression of 1921 forced the obsolescence of out-of-date machinery and methods. The depression of 1931 calls for the discarding of obsolete materials."

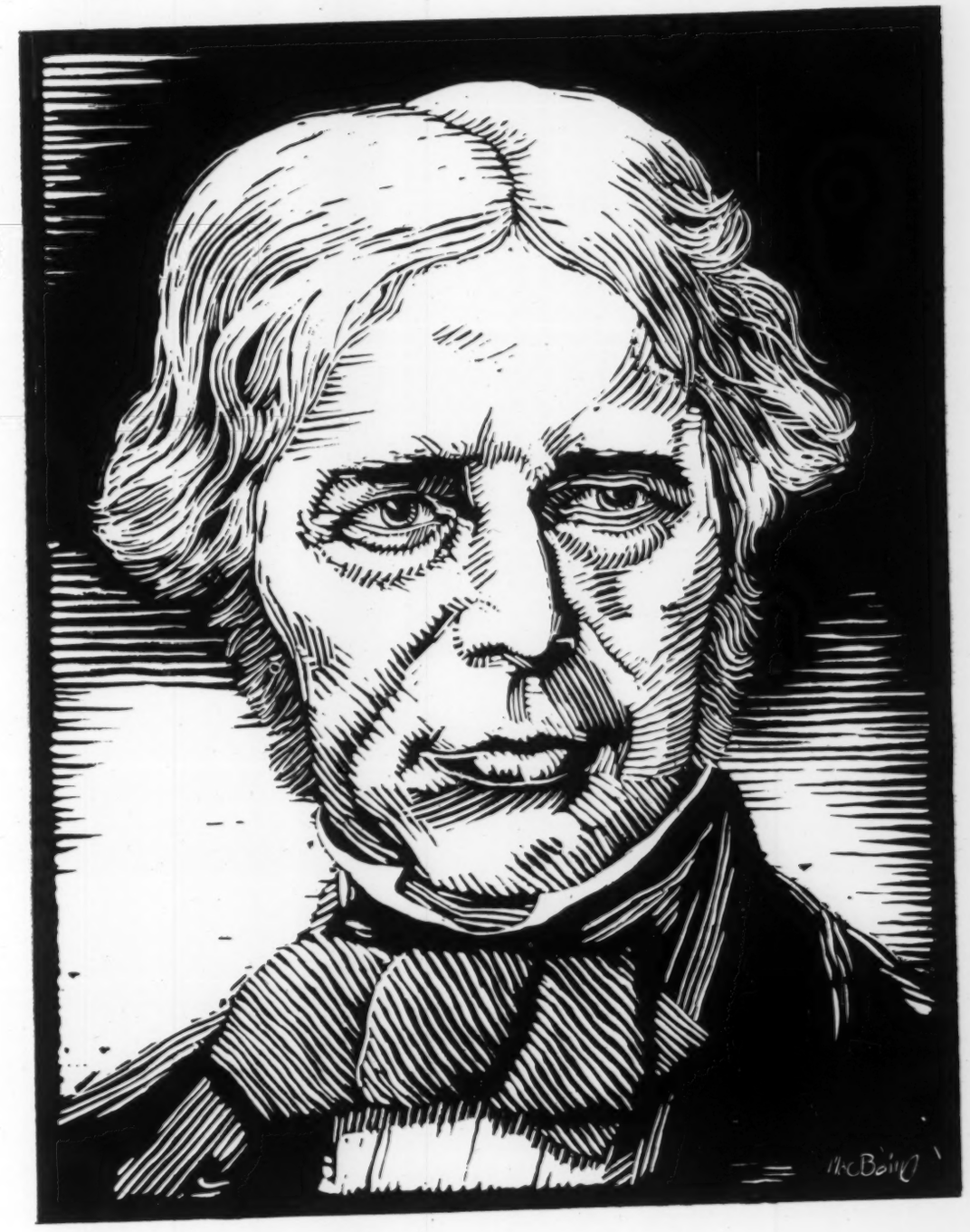
Engineers and others engaged in the design of machinery will do well to consider the significance of these statements. A casual examination of many of the new machines now being introduced will reveal astounding evidences of misapplication of material. Too frequently one sees parts three or more times as heavy as they need be, simply because the designer has not kept informed on the availability of improved steels and nonferrous metals.

Builders of machines are loud in their condemnation of obsolescence of equipment in the plants of their customers. However, their zeal in this respect should not blind them to the waste involved in obsolete materials in their products.

Can His Achievements Be Equalled?

IT WOULD ill become MACHINE DESIGN to let this issue pass without fitting words of testimony in honor of the memory of one of the world's greatest inventors, Thomas A. Edison. His passing is mourned in every civilized country and by men in every walk of life; but by none more than those engineers who are in the best possible position to appreciate his work and the benefactions he has bestowed on mankind through his inventive genius.

That others will follow him there is no question; nor that a certain degree of success will attend their efforts. It is to be remembered, however, that Edison not only was an electrical "wizard" but also an outstanding figure in the mechanical and other fields. His versatility and untiring energy should serve as a stimulant to rising engineers and scientists of the present decade and of the future. Effectively to emulate his achievements would be an ambitious goal.



Michael Faraday

Master Designers

Michael Faraday

CONVERT magnetism into electricity!" A simple sentence, but this command written by Michael Faraday in his notebook in 1822 and followed with indefatigable patience resulted, in 1831, in discoveries that made possible the transformer, the dynamo and the electric motor. It was not until 1871 that the dynamo became a commercial success, but Faraday's discovery that mechanical energy could be transformed into electrical energy and back again is the bulwark on which the stupendous advance has been made.

MICHAEL FARADAY, born at Newington, Surrey, England, in 1791, was characterized by his methodical persistence. As a boy he was apprenticed to a bookbinder, and here he received the privilege of studying the books he bound. This experience, a short time spent in common school and the information gained from his laboratory work was his sole educational experience.

REVERED primarily because of his electromagnetic principle, Faraday was one of the most distinguished discoverers in chemistry in his age. He was the first to discover benzol and butylene, and to produce liquid chlorine. He searched for many years for a noncorrosive steel, discovered the solubility of naphthalene in sulphuric acids, and conducted considerable research on electro-chemical decomposition.

IN HIS first letter to Sir Humphry Davy, who gave him his opening to science, Faraday characterized Science as a mistress who made her pursuers amiable and liberal. He never deviated from this belief. For many years he was a leading figure in the Royal Institution and the Royal Society. His great prowess could have brought him many honors and considerable wealth but he declined all but that of fellow in the Royal Society and died a poor man believing the pursuit of money beneath the dignity of a true scientist.

PROFESSIONAL VIEWPOINTS

Publication of letters does not necessarily imply that MACHINE DESIGN *supports the views expressed*

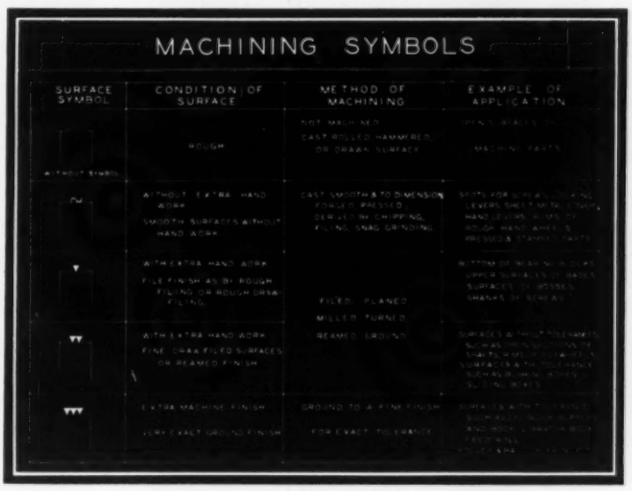
Comments from Our Readers. Machine Design Will Pay for Letters Suitable for Publication

Finish Marks Need Modernizing

To the Editor:

ANY method that enables a more comprehensive understanding of procedure by production departments is conducive to the maintenance of a set time schedule, a necessary requisite in these times when real effort is necessary in common sense control. If such a method can be standardized and applied systematically to all items of production in a machine plant, any desired quality of product can be maintained consistently.

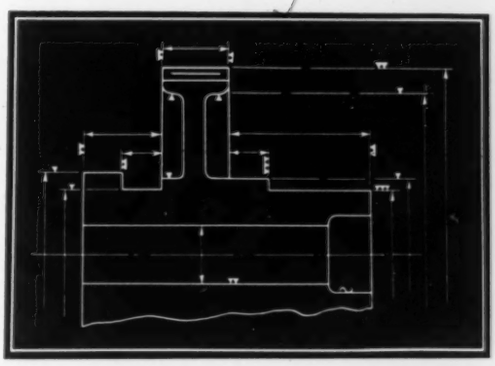
To accomplish such results, it is important that all persons performing operations have an exact knowledge of the quality of finish desired. Standardized symbols for various grades of finishes, shown herewith, can be furnished every



Standardized finish marks enable better control of finishing operations

operator in the form of a letter size blueprint mounted on a piece of stiffer material in order that it may be hung near the machine for reference.

The degree to which a surface is finished cannot be expressed in the antiquated finish marks normally placed on drawings. With the blueprint shown, this degree can be controlled accurately. The fourth column can be modified in working to suit the individual products. The sample blueprint was designed to control the manu-



Gear drawing on which standard finish marks are used

facture of gears, printing presses, special machinery, contract machine work and screw machine products.

A blueprint of a gear is also shown, on which the conditions illustrated on the control print are indicated.

—S. A. SMITH,
Boston, Mass.

Bringing Gearing Formulas Up To Date

To the Editor:

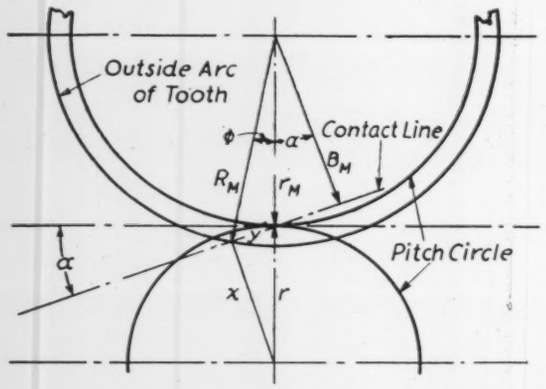
THE practical manner in which Geo. H. Middleton has written "Bringing Gearing Formulas Up To Date," is an excellent stimulus to increased interest in gear design. The questions bring out just the points that need attention in design and supply formulas to produce desirable properties. But before letting the subject pass, I believe that one other property of a gear tooth should receive attention.

Emphasis has been laid upon the effect of fillets in strengthening or weakening all sorts

of steel castings, forgings or machined parts, and gears are not excepted from this classification. Without a doubt, the larger the fillet the stronger the tooth, for it has been shown that when there is a sudden change in the area of a stressed section there will be a concentration of stress at or near the place where the sudden change in area takes place. Although not all gear teeth have circular arc fillets it is interesting to know how far up the side of a tooth any kind of a fillet may reach without under cutting taking place, more particularly in the case of cast gears. Following the method adopted by Mr. Middleton, I would add the following question:

What is the largest possible fillet at the root of the tooth?

Expressed in words, the problem is to find



Essential dimensions of a pair of mating gears and the line of action

the location of the spot on a tooth struck by the point of the mating gear tooth at the last stage of contact and subtract the root radius from the radius to the spot struck. This will give the largest fillet radius. The accompanying figure shows only the essential dimensions of a pair of mating gears and the line of action or contact line.

The dimensions are defined as follows:

a = angle of action
R_m = radius to outside of mating gear tooth
B_m = base circle radius of mating gear = $r_m \cos a$
r_m = pitch circle radius of mating gear
y = distance between point of tangency of pitch circles and point of intersection of contact line and outside arc of mating gear tooth
x = closest radius at which point of mating gear tooth strikes tooth of gear

It is obvious from the geometry of the figure that

$$y = \sqrt{R_m^2 - B_m^2} - r_m \sin a$$

and

$$x = \sqrt{y^2 + r^2 - 2yr \sin a} \text{ (cosine law)}$$

Then

Max. fillet radius = x —(radius to root of tooth)

Another method not quite so accurate but quicker employes the triangle whose base is $(r+r_m)$.

$$\cos (a + \Phi) = \left(\frac{R}{B}\right)_m$$

$$x = \sqrt{R^2_m + (r + r_m)^2 - 2R_m (r + r_m) \cos \Phi}$$

—G. M. Van Voorhis,
East Cleveland, O.

Bringing Gearing Formulas Up To Date

To the Editor:

AS AUTHOR of "Bringing Gearing Formulas Up To Date," which appeared in the August and September issues of Machine Design, I am surprised by the statement from the Brown & Sharpe Co. that the B. & S. standard system of gearing has a pressure angle of exactly 14 degrees 30 minutes and is not 14 degrees 28 minutes 39 seconds ($\sin^{-1}=0.250$). There is every reason to believe that many gear specialists hold the same opinion, in fact, the idea has been advanced that the convenient sine value of ¼ is the very *raison d'etre* of the fractional degree pressure angle, otherwise 15 degrees would have been retained as there were various odontographs of this angle, and it was easy to lay out.

As far as I have been able to learn by systematic research through gearing history, Oscar J. Beale in *Blue Book on Gearing*—the forerunner of the present B. & S. *Practical Treatise on Gearing*—used the sine value of ¼ without stating that this was approximate. Naturally, as I have found no contradiction in a rather deep study of the literature of the subject, I accepted the opinion. Several other specialists are known to have the same views.

I regret sincerely that such a mistake, even though made in good faith, should have occurred; but I am rather glad to have been the means of bringing the error to light and correcting the impressions of several gear men who hold this opinion.

The change from 0.2500 to 0.25038 as sin β, certainly spoils the simple formulas given for gear calculations, but the error is not sufficient to cause variation more than approximately 1/7 of 1 per cent. The maximum length of contact possible is that of two racks, uncorrected, and using a pitch of 1 D. P. the length as given is 8 inches. With an angle of 14½ degrees exact, maximum length is 2 cosec $\beta=2\times3.99393=$ 7.98786 inches, a difference of 0.012-inch in 8 inches or approximately 1 in 700.

In terms of numbers of teeth, maximum contact=8 inches$\div\pi \cos \beta$; 2.630 (not 2.62 as given in the article). With 14½ degrees exact pres-

sure angle, maximum contact=7.98786÷π cos β=2.626 teeth. These will represent maximum differences in the calculated values.

In actual tooth curves the difference must be slight indeed as I have found that cutters designed on the 14 degrees 28 minutes 39 seconds basis would work with perfect satisfaction with mating gears cut with gear cutters made by the B. & S. company. This again seemed to be a confirmation of the opinion expressed in the article.

—GEORGE H. MIDDLETON,
Danbury, Conn.

Designing Bolts for Shock Loads

To the Editor:

I DO not see that anything is gained by Professor Ault's extension of the formula

$$p = \frac{2W}{A}\left(\frac{h}{d} + 1\right) \qquad \text{.....(1)}$$

first presented in the September, MACHINE DESIGN, to the form

$$p = \frac{W}{A}\left(1 + \sqrt{2\,\frac{h}{\delta} + 1}\right) \qquad \text{.....(2)}$$

as given in his article in October, especially when making original designs. For checking members already designed and in service I believe the following equation to be superior to either, as it does not require a determination of d or δ:

$$p = \frac{W}{A}\left(1 + \sqrt{\frac{2A\,E\,h}{W \times l} + 1}\right) \qquad \text{.....(3)}$$

where E is the modulus of elasticity and l the length of the bolt, or member. This equation is obtained readily from (1) by substituting pl/E for d and solving the resulting equation for p.

For new designs, which was the scope of my article, the first equation appears to be the simplest and most convenient. In making original designs, the stress p is assumed, as are all allowable stresses, its value depending upon the physical properties of the metal. The load W is known so the unknown factor is the size of the bolt. Obviously, none of these equations lend themselves to a direct determination of the bolt size. The usual method is to assume a bolt and then check its strength by means of the equation. This can be done more easily and more quickly by employing the first equation. Here d is obtained readily from the equation $d=pl/E$. If the second equation were used, δ would have to be obtained from the equation $\delta=Wl/AE$ and this value substituted in the second equation, which requires the extraction of the square root. It is for this reason that I believe the first equation more suitable for making original designs, especially since the problem in any case must be solved by the cut-and-try method.

Professor Ault's comments in regard to exercising care in determining the deflection either d or δ are important. It is common practice to base the deflection in the threaded portion of the bolt upon the mean area of this portion.

—JAMES I. CLOWER,
South Orange, N. J.

Find the Untapped Markets!

To the Editor:

YOUR editorial in the September issue of MACHINE DESIGN which referred to the successful attempt of a shoemaking machinery builder to stimulate his sales by canvassing customers as to their needs is a timely presentation.

The writer feels that engineers as part of their job should create the same opportunity of which the enterprising New England manufacturer you refer to has taken advantage. Mechanical engineers frequently are in a position to study existing machinery from a replacement viewpoint. Many machines are plodding along at a speed which was thought suffcient or the ultimate at the time the design was originated.

Engineers might well study camshafts for example to see if there is waste in operating time. Often a machine cycle has been found to contain time elements which a change in design could turn into pure velvet as a producer. Many purely mechanical movements thought necessary for design five or ten years ago can be supplanted to distinct advantage with newer electric or pneumatic power units. The writer has seen many instances of improved performance and efficiency result from just such a survey as your well taken editorial portrays.

The conclusion which this brief discussion brings is that mechanical engineers as a class should search their own fields for dividend paying remodelling or machine combining possibilities. In addition, hand manufacturing operations or methods should be analyzed with the thought that new equipment to lower manufacturing costs might be designed. No wide-awake executive can afford to disapprove appropriation requests for machine building or remodelling when the engineer's report shows clearly that increased output at lower cost will result.

Thus, in one way the mechanical engineer may do his bit to stimulate machine development and help alleviate the depressed condition in manufacturing industries.

—H. R. POLLEYS,
New Haven, Conn.

MEN OF MACHINES

Personal Glimpses of Engineers, Designers, and Others Whose Activities Influence Design

IN THE engineering profession the name of Dr. Frederick William Lanchester ranks as one of the foremost English leaders, particularly in the automotive and aircraft industries. Indicative of his activities in the latter field is the recent award of the third Daniel Guggenheim medal for his notable contributions to the fundamental theory of aerodynamics. The presentation was made on the occasion of the reading of the Wilbur Wright memorial lecture before the Royal Aeronautical society in London.

Dr. Lanchester, a resident of Birmingham, England, was born Oct. 23, 1868. His scholastic education was obtained at the Royal College of Science. From 1890 to 1894 he was designer and works manager, Forward Gas Engine Co., Birmingham, and during the following four years was engaged in the development of the Lanchester motor car. During the period 1900-04, Dr. Lanchester was general manager and chief engineer, Lanchester Motor Co. Ltd.

His later record includes a membership on the advisory committee for aeronautics, consulting engineer and technical advisor to the Birmingham Small Arms Co. Ltd., and the Daimler Co. Ltd. Dr. Lanchester is an honorary fellow, Royal Aeronautical society and member of the Royal Automobile and Royal Cruising clubs.

TODAY, at the age of 37, C. L. Egtvedt is not only vice president and director of the Boeing Airplane Co., Seattle, Wash., but he also is vice chairman of the technical advisory committee of the United Aircraft & Transport Corp. His recent appointment to active managership in the Boeing organization follows steady advancement since he entered the services of this pioneer airplane plant soon after his graduation from the University of Washington in 1917.

Mr. Egtvedt began work in the engineering department, having majored in engineering at the university, and after two months of airplane design and stress analysis was made assistant chief engineer. In 1918 he was advanced to the position of chief engineer, in which capacity he remained for four years. Secretary in 1922 and vice president in 1926 were his next offices.

At the present time Mr. Egtvedt is engaged in supervising the construction of 135 pursuit planes and seven large bombers for the army, as well as 75 fighting planes for the navy, in addition to various commercial and experimental construction.

DISTINGUISHED as the discoverer of an outstanding magnetic alloy, Dr. Trygve D. Yensen has contributed to the design profession the results of long and tedious but fruitful study of iron silicon and iron nickel materials. His findings in the Westinghouse Electric research laboratories of which he is manager of the magnetic division have been translated into practice. Consequently there has been a steady annual improvement in the quality of electrical sheet iron, until now the commercial material almost is as good as the laboratory product of a few years ago.

Dr. Yensen was born in Drammen, Norway, in 1884 and received his early scholastic training there. Then he came to the United States and enrolled as a student at the University of Illinois, where he was graduated in 1907. In 1911 he received the degree of electrical engineer and was made master of science in 1912, all at Illinois. After he became identified with Westinghouse in 1916 he went to the west coast for intensive study in connection with special work and in 1927 the California Institute of Technology conferred upon him the degree of doctor of philosophy in physics.

Recent activities of Dr. Yensen include the presentation of a paper on "Magnetic Iron and Steel" at the meeting of the Iron and Steel Institute. He holds membership in several engineering and scientific organizations.

BY RECENT appointment Rudolph E. Peterson became manager of the mechanics division, Westinghouse research laboratories at East Pittsburgh, Pa. This is another step in his remarkably rapid rise in engineering. Mr. Peterson is yet quite a young man, having been born Nov. 8, 1901, at Oregon, Ill. He is a graduate of the Rockford high school and University of Illinois, receiving his degree in mechanical engineering in 1925, and his master's degree

Leaders in Design, Engineering and Research

F. W. Lanchester

C. L. Egtvedt

T. D. Yensen

R. E. Peterson

in theoretical and applied mechanics the following year.

Joining the Westinghouse company he worked in railway and motor engineering, becoming a member of the laboratory staff in 1927. Three years later he was made section engineer in charge of the strength of materials section. From 1926 to 1930 he served as part time instructor in theoretical mechanics and strength of materials at Carnegie Institute of Technology.

Mr. Peterson designed and developed silencing rings for gears. He was author of a paper on the "Theoretical Aspect of Tip Relief," presented recently before the semiannual meeting of the American Gear Manufacturers association at Pittsburgh, and at the Third International Congress of Applied Mechanics at Stockholm he gave a scientific paper. He holds membership in the American Society of Mechanical Engineers and in the American Society for Testing Materials.

* * *

Harold F. Shepherd, formerly associated with Cooper-Bessemer Corp. of Mount Vernon, O., as assistant chief engineer is now connected with International Stacy Corp., Beaumont, Texas. Mr. Shepherd is well known in the diesel and gas engine field and has contributed a number of articles to MACHINE DESIGN on the development of this type of equipment.

* * *

Frank L. Eidmann, professor of mechanical engineering, Columbia university, has been appointed director of the research and experimental laboratories of the General Time Instruments Corp., which is the holding company of the Western Clock Co., Seth-Thomas Clock Co., Stirling Clock Co., and Hamilton-Sangamo Co. He will retain his university connection.

* * *

Harry W. Houck has been appointed assistant chief engineer of Kolster Radio Corp. and will be stationed at the engineering laboratory in Newark, N. J. He resigned his former post as chief engineer of Dubilier Condenser Corp. after a 10-year association. Mr. Houck has been granted numerous patents on radio inventions.

* * *

Dr. Michael I. Pupin, Columbia university, New York, has been awarded the John Fritz gold medal for 1932 by the unanimous consent of board members of four national societies of civil, mining and metallurgical, mechanical and electrical engineers for his achievements as scientist, engineer and inventor.

* * *

Charles O. Guernsey, chief engineer, automotive car division, J. G. Brill Co., Philadelphia, since 1923, has been made chief engineer of the company and its subsidiaries. For ten years previous he was affiliated with the Service Motor Truck Co., Wabash, Ind., as chief engineer and later as vice president in charge of the company's railroad division, the activities of which were transferred to the Brill company in 1923.

* * *

Frank B. Rowley, professor of mechanical engineering and director of the experimental engineering laboratory at the University of Minnesota, has been nominated for president of the American Society of Heating and Ventilating Engineers for 1932.

* * *

Howard H. Cook recently was elected secretary of the American Iron and Steel institute. He has been connected with the organization since 1910, having previously served as a special agent of the department of commerce in the study of economic conditions in the iron and steel industry, including reserves of raw materials, cost of assemblage and cost of manufacture of finished products.

* * *

Charles P. Mills, recently director of the chrome alloy department, General Alloys Co., Boston, has resigned to become chief engineer of Empire Steel Castings Inc., Reading, Pa. Mr. Mills is an authority on heat and corrosion resisting chrome iron and chrome nickel castings and for many years was chief engineer of the Duraloy Co., Pittsburgh.

* * *

H. D. Reed, Bishop Wire & Cable Co., New York, has been appointed by the National Electrical Manufacturers association as its representative on the standards council of the American Standards association. H. A. Calderwood, electrical engineer, National Molding division, Electrical Products Corp., Pittsburgh, is alternate for Mr. Reed on the council.

* * *

Dr. Lillian Gilbreth recently was awarded the first Gilbreth medal, established by the Society of Industrial Engineers, for her contribution to scientific management. The medal commemorates the work of the late Frank B. Gilbreth and will be awarded annually.

* * *

Paul Gay, for four years past chief engineer of the Charlotte, Mich., plant of Sterling Mfg. Co., Cleveland, has been appointed chief engineer at Cleveland.

* * *

Dr. L. V. Redman, vice president and director of research of the Bakelite Corp., has been awarded the Grasselli Medal, industry's annual tribute to distinction in applied chemistry, it is

(*Continued on Page* 62)

Assets to a Bookcase

Review of Books Pertaining to Design

The Plastic State of Matter

Plasticity, by Dr. Ing. A. Nadai, 349 pages, 6 x 9 inches; published by McGraw-Hill Book Co. Inc., New York, and supplied by Machine Design for $5.00 plus 15 cents postage.

The subject of this book covers the mechanics of the plastic state of matter and presents for engineers and designers the fundamentals of the theory of plastic flow in materials, particularly in metals. Besides being concerned with one important part of the theory of strength of materials, it is based on the best methods of engineering and on up-to-date results of laboratory tests.

Part I deals specifically with mechanical engineering problems, discussing, among other things, effects of grain structure and changing temperature upon strength, elastic and permanent deformation, unit shear, principal strains, normal and shearing stress, hardness, inherent and residual stresses, etc.

In the initial chapter Dr. Nadai observes that it is an established fact that even the strongest metals, such as steel and iron and materials with crystalline structure, under certain definite mechanical conditions may be brought into a new state—the plastic state—in which permanent deformation may occur without fracture.

Dr. Nadai's book has been selected as a monograph of four national engineering societies, including the American Society of Mechanical Engineers. The author was assisted in the translation from the German, in which language the volume originally was published, by A. M. Wahl.

□ □ □

A Textbook for Engineers

Engineering Mechanics, by Frank L. Brown, 477 pages, 6 x 9; published by John Wiley and Sons, New York, and supplied by Machine Design for $4.00 plus 15 cents postage.

Fundamental principles of engineering mechanics that are of importance to the engineer in the ordinary course of events are contained in this volume which has been designed by the author as a textbook. Statics is treated first, in Part I. In Part II, kinematics and kinetics alternate as the various types of motions are discussed.

This book although intended for the student engineer will be read in part at least by numerous older engineers whose knowledge of some of these points perhaps has become more or less obscured. It is a splendid book for study because of its comprehensive presentation of the subject of mechanics.

□ □ □

Diesel Engine Design

American Diesel Engines, by L. H. Morrison, 606 pages, 6 x 9; published by McGraw-Hill Book Co. Inc., New York, and supplied by Machine Design for $5.00 plus 15 cents postage.

Publication of a book on diesel engines is particularly timely in view of the increased interest in this source of motive power. Mr. Morrison has gathered his material from prominent diesel engine manufacturers and in a thorough and complete manner gives details of design and descriptive text of various units.

Beginning with the history of the diesel engine in this country, its progress is traced, supplemented in turn by the economic aspect of its installation, modern air injection and airless injection types, oil engine installation, etc. Toward the latter part of the book design features are discussed in detail, including engine frames, main bearings, crankshafts, pistons and piston pins, connecting rods, etc.

□ □ □

For the Handbook User

The Use of Handbook Tables and Formulas, John M. Amiss, 210 pages, 4½ x 7; published by The Industrial Press, New York, and supplied by Machine Design for $1.00 plus 15 cents postage.

This new book serves three distinct purposes: First, it throws the spotlight on a lot of essential time-saving tables, rules, and general information in *Machinery's Handbook* that the ordinary user never discovers. Second, it shows by examples, solutions, and test questions, typical applications of handbook matter in both drafting-rooms and machine shops. Third, it provides test questions that will enable the handbook user, through practice, to obtain the required information quickly.

Experienced engineers will find many helpful hints in this handbook. For younger and less experienced men it provides a condensed course in mechanics, machine shop practice, and engineering, as well as a guide to practical everyday handbook usage.

TOPICS OF THE MONTH

A Digest of Recent Happenings of Direct Interest to the Design Profession

ANNOUNCEMENT that a steam engine of the turbine type is being developed for aircraft use is creating considerable discussion. Early experiments of Hiram Maxim in seeking to develop a flying machine utilizing a steam engine for power are recalled, as well as the later development in the automobile field of steam engine-propelled cars such as the Locomobile and those of White, Grout, Stanley and others.

Officials of the Great Lakes Aircraft Corp. express confidence in the success of their new venture, believing that the chrome nickel alloys now available will resist effectively the high temperatures, pressures and corrosion which, taken in combination, would have served to make the development of a steam engine for aircraft impractical with materials formerly on the market.

It is claimed that the new type of power plant, complete with the crude oil to be used for fuel and the small amounts of water and oil necessary, will compare favorably with the gasoline engine in respect to weight in pounds per horsepower developed. If this proves possible and the engine is successful in other ways, the effect will be revolutionary and too far reaching to hazard a decided opinion on it at this time.

* * *

Sees Need for Patent Pool in Radio Industry

A VOLUNTARY pool of electronic patents would give impetus outside as well as inside the radio and electrical industries, declares O. H. Caldwell, former Federal Radio commissioner, who believes that such a pool would go a long way in restoring business, rebuilding confidence and directly or indirectly creating jobs for thousands of workers.

Out of each depression, says Mr. Caldwell, economists tell us some new invention of industry always has arisen to lead the world into new business activity. The automobile, for example, pulled the country out of the slough of 1921. If such is to be the way out of the present depression, he declares, then certainly on the horizon of 1931 there is no more promising prospect to perform such service than the electronic tube with all its manifold applications.

"If the owners of electronic patents could see the advantage of cross-licensing and exchanging patent privileges under a voluntary pooling plan that would stimulate both manufacture and profits, how far would the development of this art be pushed ahead? Certainly, a voluntary patent pool would speed up electronic development at least five or ten years. The public, the industry, the inventors would all be the gainers. Electronics—science's latest greatest gift to mankind—is straining at the leash."

* * *

Office Machines Show Marked Development

ELECTRICAL operation and silent performance characterized the exhibits of office machines at the recent National Business show in New York. Desk radio sets, intricate payroll check writing machines, high speed printing and billing machines were typical of the numerous new designs offered there for the first time.

Among the outstanding units shown were: A hotel front-office posting machine which has an automatic credit balance; a new check-writing and signing machine which itemizes and prints various additions and deductions from pay checks and extends the net total; a new automatic cutting and sorting machine which cuts checks and stacks them in numerical order thus eliminating perforations and the labor and nuisance of tearing checks apart.

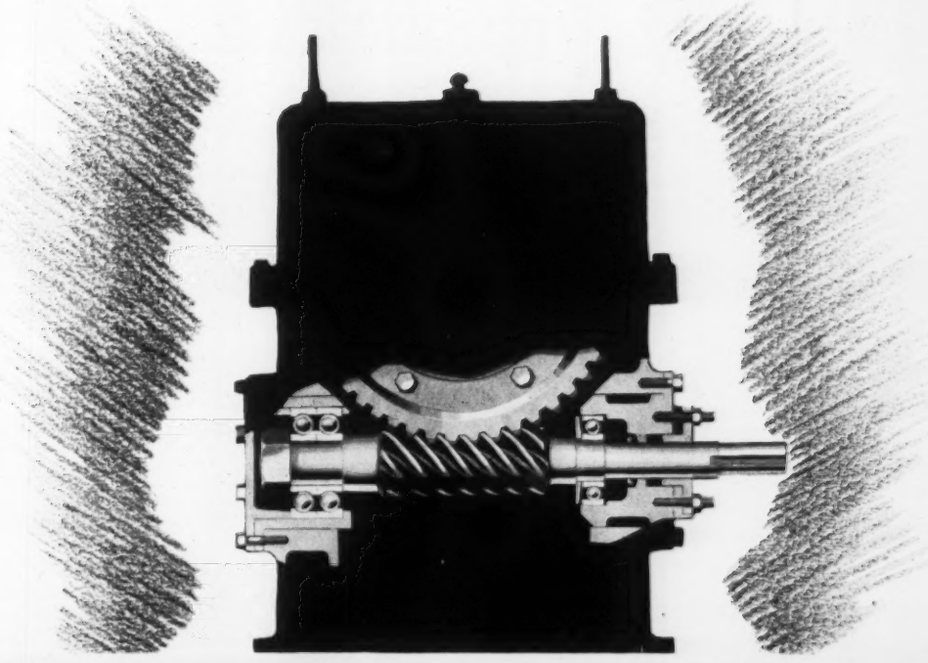
Another interesting machine shown for the first time was a post card printer and addressing machine which prints a message on the back of the card and the address on the front in a single operation. Still another device prints telephone bills, addresses them four times and scores the stubs at the speed of 3000 per hour.

* * *

Engineering Council Plans Mobilized Aid

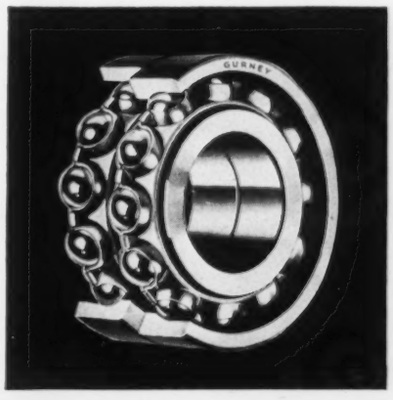
MOBILIZATION of the nation's engineers behind President Hoover's program to end the depression is planned by the American Engineering Council. The aid of more than 100,000 engineers will be enlisted in a movement to increase and to stabilize employment, and to oppose the adoption of unwise legislation, federal, state, or municipal.

The council will work with the relief organi-



"Nothing but the Best" – hence GURNEY *"Duplex"* BALL BEARINGS *in* CLEVELAND WORM GEAR SPEED REDUCERS

THE Cleveland Worm & Gear Company have manufactured worm gear reduction units for over 18 years. They pioneered the use of anti-friction bearings in these units and today are recognized for the outstanding quality and reliability of their product. The use of Gurney Ball Bearings in Cleveland worm gear units dates back nearly 10 years — which surely qualifies us to attest the stringent "nothing-but-the-best" policy of this organization.



The illustration shows a Gurney "Duplex" on the dead end of the worm—an installation in which this bearing has long served. It is used because of its tremendous thrust capacity and because it can be preloaded for lasting rigidity. In short, the Gurney "Duplex" clamps the worm in proper alignment — keeps it meshing properly — holds it in adjustment through the long, hard service to which speed reducers are constantly subjected.

For nearly 10 years Gurney "Duplex" Ball Bearings have proved themselves in Cleveland Worm Gear Speed Reducers . . . it is a bearing YOU should use for solving shaft support problems involving Rigidity — Accuracy — or high thrust Load Capacity. Gurney Ball Bearing Division, Marlin-Rockwell Corporation, Jamestown, N. Y.

GURNEY BALL BEARINGS

zation set up by the President under the headship of Walter S. Gifford, president of the American Telephone & Telegraph Co. The aim, it was said, is not only to promote emergency measures but to develop sound permanent employment policies throughout American industry.

F. J. Chesterman of Pittsburgh, vice president and general manager of the Bell Telephone Co. of Pennsylvania, has been appointed chairman of a national committee to direct the engineering effort, which will be carried out in detail by committees to be named in every state. These committees will co-operate with the industries and with civic and business bodies.

* * *

Machinery Census Shows High Values

PRACTICALLY all lines of industrial machinery produced in the United States in 1929 showed sharp increases in value over 1927, according to the bureau of census, department of commerce, Washington, which has just released a report on machinery in connection with the fifteenth census of manufacturers.

Indicative of the rapid progress made in welding was the $13,582,949 value of welding equipment in 1929, as compared with $7,090,517 in 1927. Machine tools, which were valued at $105,554,913 in 1927 and only $91,459,403 in 1925, jumped to $186,060,949 in 1929.

* * *

Safety Considered in Modern Design

SPEAKING on safe practices in machine development at the recent meeting of the National Safety council, S. Morgan, Buick Motor Car Co., brought out several points which are especially pertinent to design. Alluding to the work of machine tool manufacturers, he stated that today with modern designing, the safety factor is considered on the drawing board before the machine is built. "They do not wait until the machine is finished and then walk around and pick out the hazards."

A great deal of attention, he declared, has been given to the application of hydraulic pressure in machine tools. This is true, particularly, in recent design. The use of hydraulics eliminates some of the hazards and makes for greater safety, he believes.

* * *

Free-Wheel Propeller Designed for Airplanes

CONSIDERABLE saving may be effected in airplane operation by the use of a free-wheel propeller, recent tests revealed. According to aeronautical experts of the Society of Automotive Engineers, this new type of propeller is free from vibration and may be used with either high or low speed equipment. The device, it is believed, will be available for all forms of propellers: wood, aluminum, and steel. It makes no change in the operation of the airplane except to give a greater feeling of accelerative freedom familiar to those who have driven free-wheeling motor cars.

* * *

Cornell Scientist Discovers New Element

RECENTLY Dr. Jacob Papish, professor of spectroscopy, Cornell university, Ithaca, N. Y., announced the discovery of element No. 87, thereby leaving only element No. 85 unidentified. The new element is found in a lustrous, velvet-black mineral called samarskite, which is worth about $2 a pound. Two million pounds of the mineral would contain 1 pound of the element, according to the calculations.

Element No. 87 is an insoluble solid and cannot be isolated because of its high inflammability. It is unusually sensitive to light and because of this it may have interesting possibilities for use in connection with photoelectric tubes and the like.

* * *

Delivers Lecture on Machine Age

THE balance sheet method of evaluating the benefits and disturbances created or caused by present-day machinery and methods was adopted by Stuart Chase, well known author of *Men and Machines,* in a lecture given recently in Cleveland. On the credit side he placed factors such as the elimination of much manual work, longer lives, more leisure and greater health.

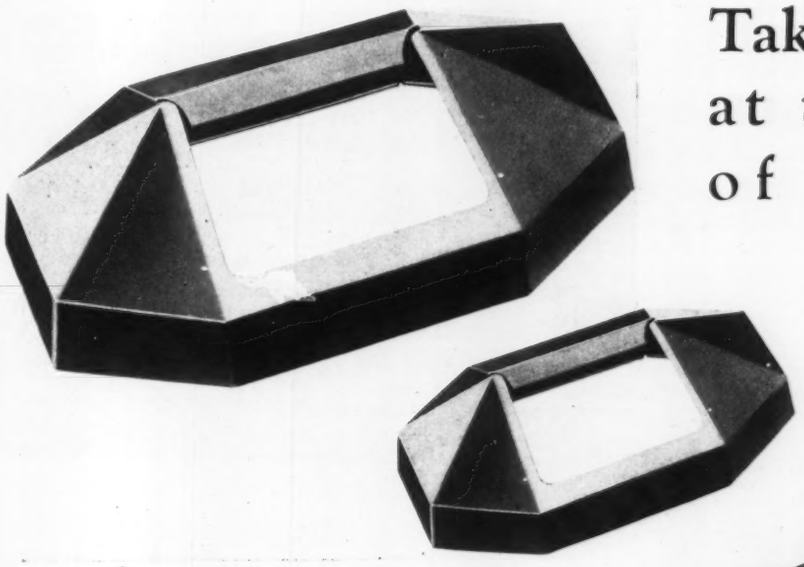
On the debit side, however, Mr. Chase found an almost unending stream of disadvantages. In the first place he laid stress on the horrors of mechanized warfare, following this with the statement that we are living on our economical capital in using up our natural resources of gas, coal and oil for some of which, in his opinion, it may be impossible to find substitutes. He further claims that one-half of our hospital beds at present are occupied by people suffering from nervous disorders brought about by the "Machine Age," and also that the machine is responsible for much of the existing so-called "technological unemployment."

Granting there is food for thought in the statements made by Mr. Chase, the fact remains that engineers who attended the lecture are emphatically of the opinion that he overlooked numerous factors influencing modern civilization as contributed to by up to date machinery. Possibly the greatest of these is the fact that many economists have failed to keep pace with engineering progress, with the result that only recently has the subject of economics begun to assume its rightful place.

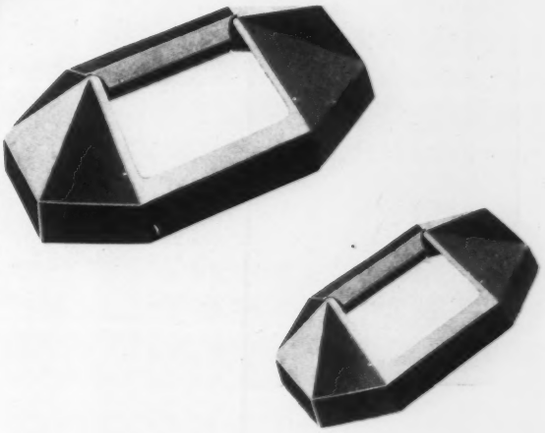
Ralph E. Flanders in his book *Taming Our Machines* discusses these problems at length from an interesting and authoritative angle. A review of the book appears on page 34.

you Can't Cut Costs?

Take another look at this question of stampings.



A 22 gauge Seamless Steel Ticker Case manufactured by G. P. & F. for a leading manufacturer.



THE foreigner travels thousands of miles to see the Chicago Stockyards. But the Chicagoan never goes and wonders why such a fuss is made about them.

The same with cost-cutting methods. Because they may seem like "old stuff" you are apt to overlook their value altogether.

In today's need for price readjustment consider your product all over again in the light of G. P. & F. stampings. Or better still, let us do the considering. We're used to it and may see several places to economize where you see none. G. P. & F. have had 50 years experience in the business of saving money for manufacturers, in making products more attractive, more salable, and more durable.

Reconsider the question of *your* using stampings. Send us a sample of your product—or a blueprint. Meantime, get the booklet *"In Harmony With Modern Progress."* It's free.

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NOTEWORTHY PATENTS

A Monthly Digest of Recently Patented Machines, Parts and Materials Pertaining to Design

SEVERAL ingenious ideas are employed in the recently patented paper winding machine designed by Earl E. Berry, Beloit, Wis. The unit embodies an interesting means of removing the reels of wound paper without imposing a tremendous strain on the winding shaft, a condition which prevails when overhead cranes are employed. With this new arrangement lighter shafts on which to reel the paper may be used.

Instead of driving the winding shaft direct, the two cylinders in contact with the paper rolls are driven, imparting rotation to the reel of paper. The position of the under-drums 4 and 5 when the winding operation is in progress may be seen in Fig. 1. The invention, however, is directed more particularly to the arrangement and mounting of the under-drums to permit them to be tilted or rocked to discharge the wound roll on shaft 6 over the surface of one of the drums upon the receiving platform.

To accomplish the principal object of this invention the cradle 11 carries under-drums 4 and 5 and is provided with arcuate-shaped, spaced flanges 18 and 19 which rest on similar shaped bearing surfaces. An arcuate-shaped tongue 24 positioned between the flanges 18 and 19 is provided at its rear end with racked teeth 25 adapted to mesh with pinion gear 26. Provision

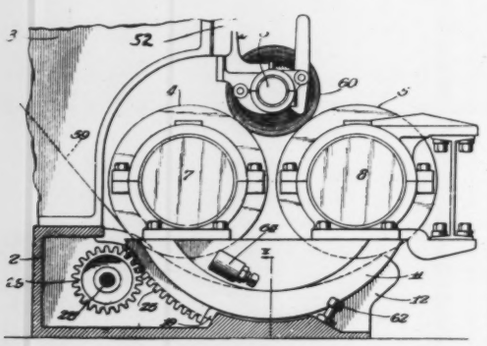


Fig. 1—Paper is wound on roll 60 by frictional contact with drums 4 and 5

of friction disks allows sufficient slippage in the drive connection between the motor and the rack gears on the cradles to prevent injury to the motor when movement of the cradle is impossible.

Winding shaft 6 is supported at its ends in split bearing clamps 51 mounted on the lower ends of vertically adjustable rods 52. These rods slide in guideways formed in the upright side frame members and are connected to counterweights by cables strung over pulleys. A handwheel serves to raise and lower the rolls of paper when desired.

When the winding machine is in operation a

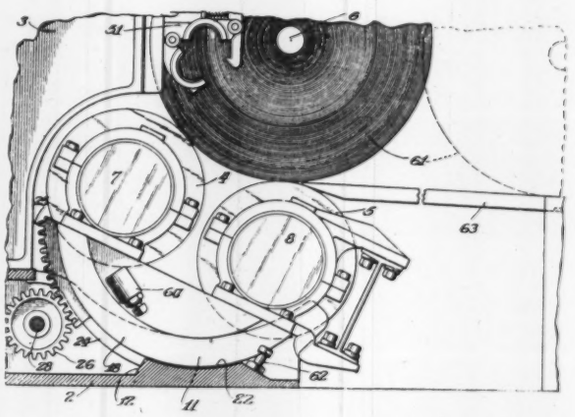


Fig. 2—Tilting of drums 4 and 5 effects the removal of roll of paper from machine

web of paper 59 is threaded under the drum 4 and its end wrapped about the shaft 6. The under-drums 4 and 5 then are set in motion and the web of paper wound upon the shaft 6 by surface contact with the revolving drums. To remove the reel 61 from the winding drums, bearing clamps 51 are disengaged and the motor started up to effect a partial rotation of the cradle members. The under-drums 4 and 5 thus are tilted as shown in Fig. 2.

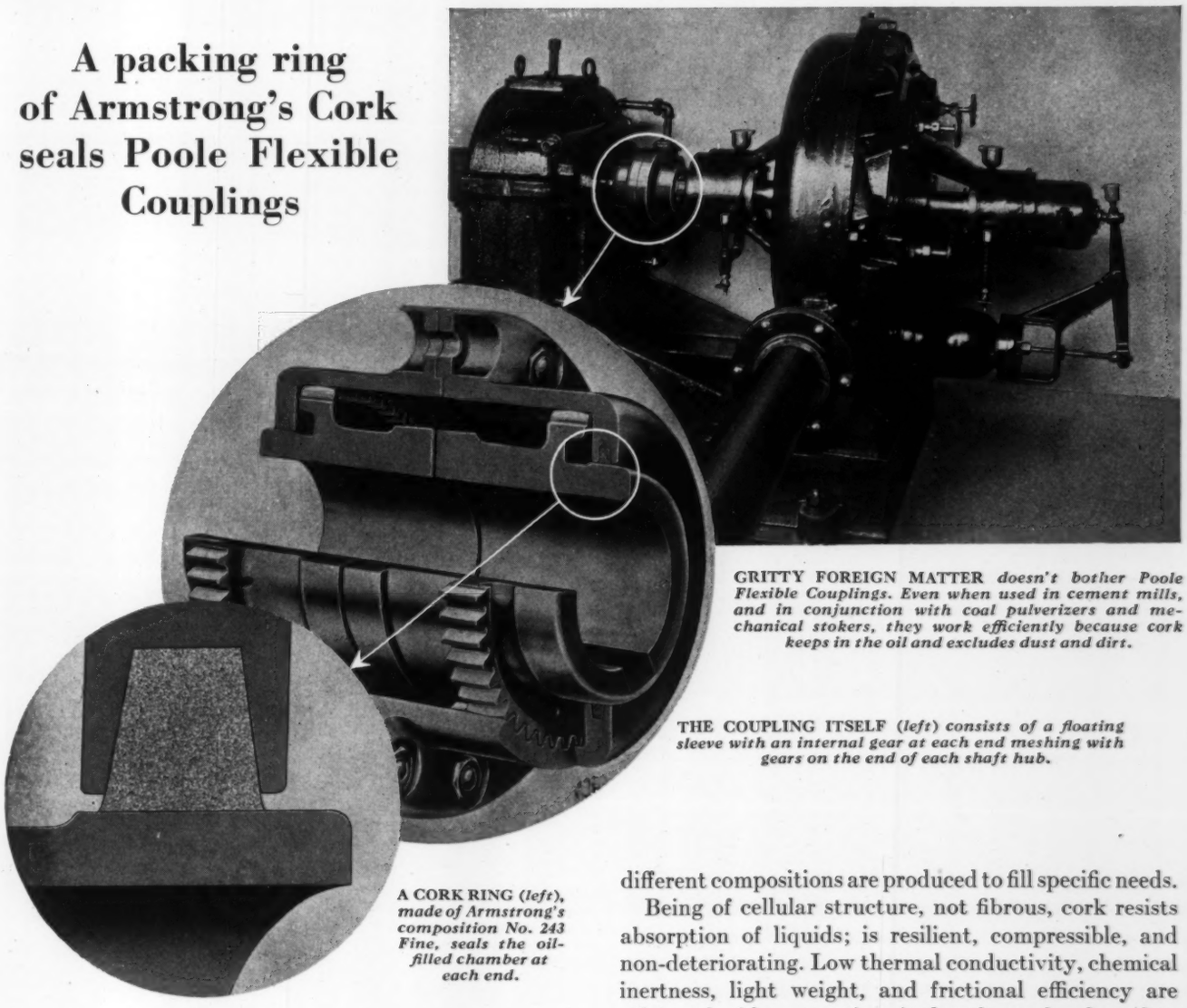
Stop members 62 at the front of the cradle supporting frame prevent rocking of the cradle through too great an arc. The full reel of paper 61 then rolls over the surface of the drum 5 upon the platform 63 as shown in the dotted lines. Fig. 2.

The patent for this invention has been designated No. 1,826,041 and the Beloit Iron Works, Beloit, Wis., is named assignee.

OILLESS, noiseless and free from vibration or rattle are features of a recently patented rolling bearing developed by Bradford B. Holmes

OIL *stays in* . . . DIRT *stays out*

A packing ring of Armstrong's Cork seals Poole Flexible Couplings



GRITTY FOREIGN MATTER *doesn't bother Poole Flexible Couplings. Even when used in cement mills, and in conjunction with coal pulverizers and mechanical stokers, they work efficiently because cork keeps in the oil and excludes dust and dirt.*

THE COUPLING ITSELF (*left*) *consists of a floating sleeve with an internal gear at each end meshing with gears on the end of each shaft hub.*

A CORK RING (*left*), *made of Armstrong's composition No. 243 Fine, seals the oil-filled chamber at each end.*

AN interesting problem faced the Poole Engineering and Machine Company: What resilient material would seal this flexible coupling safely for any service? Oil must be kept in—dirt, grit, and moisture kept out.

Intensively tested and carefully checked with other materials, Armstrong's Cork proved definitely superior. Armstrong engineers were able to provide a composition that fulfilled every requirement. It retains its sealing efficiency—is not subject to progressive deterioration. This cork sealing ring lasts the life of the coupling.

The success of Armstrong's Cork Compositions for sealing, cushioning, and other industrial uses is due to formulas by which we control cork's natural properties and provide materials that meet a wide range of services. By changing the fineness to which cork is ground and screened, mixing with the different types of binders, and compressing to varying degrees, different compositions are produced to fill specific needs.

Being of cellular structure, not fibrous, cork resists absorption of liquids; is resilient, compressible, and non-deteriorating. Low thermal conductivity, chemical inertness, light weight, and frictional efficiency are other valuable properties. And cork can be shaped to meet individual requirements.

Technical aid for engineers and designers

Submit your problems of sealing, cushioning, and insulating to our staff of engineers. Many questions of friction driving, feeding, and braking are also solved with cork. Address Industrial Service Section, Armstrong Cork Company, 918 Arch Street, Lancaster, Penna.

Armstrong's (A) *Product*

Armstrong's CORK

MADE TO YOUR SPECIFICATIONS

and assigned to American Chain Co., Inc., Bridgeport, Conn. Employment of nonmetallic resilient material for the races of balls or rollers constitutes the basic design idea.

Applications of this type of bearing include swivel joints and automobile rocker arms where friction is not objectionable. Fig. 3 shows a

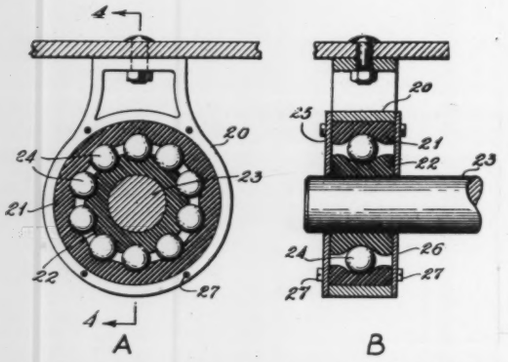


Fig. 3—Two views of rolling bearing which incorporates resilient races, etc.

modified form of the bearing using resilient races and metal balls for the rolling surfaces. Races 21 and 22 are of rubber and are positioned against the shaft 23 and casing 20. These raceways are held between the covers 25 and 26 secured in place by bolts such as 27.

The patent has been designated No. 1,798,125.

IN MILLING operations it frequently is desirable to vary the rate of speed at which one or more of the parts of a machine operates. In the movement of the feed table for instance, a certain speed may be selected theoretically but due to hard spots in the casting it may be found necessary to change the feed during operation.

This condition has brought about the development of a control mechanism designed by Sol Einstein, who has assigned his recent patent of the device to Cincinnati Milling Machine Co., Cincinnati. The new mechanism provides a control which readily is available for use by the operator from any working position so he may vary the feed as desired, thus saving both production time and effort.

Referring to Fig. 4, *A* is an enlarged section view through the control mechanism; *B* is a horizontal section on line 4—4 of *A*; a detail view of the control cam is depicted by *C*.

Design features which permit selective positioning include a miter gear 27 meshing with a similar gear 28 on the upper end of sleeve 29 which is journaled in the bracket. This sleeve bears on its lower end miter gear 30, paired and meshing with gear 31. Gear 30 is pinned on sleeve 29 and serves to support the swinging casing or housing 32 in which the sleeve is journaled. Slidable through sleeve 33 and journaled in housing 32 is control shaft 34 carrying on its forward end a nob or handle 35 for both longitudinal shifting and rotation of the shaft. Pointer 36 moving over graduated plate 37 indicates the speed changes effected through rotary movement of the shaft.

When it is desired to swing or oscillate the casing, shaft 34 is drawn outwardly, disengaging sleeve 33 and engaging the opposite face of the clutch with face 39 on lug 40 of housing. This engagement serves positively to lock the shaft and pointer 36 against movement. At the same time the shifter spool 41 on shaft 34 engages pin 42 on the latch member 43. This latch member normally is held interlocked with one of the notches 26 of flange 25 as by spring 44, but can be released by shifting the rod. When so released it will be seen that the housing and associate parts may be swung about sleeve 29 as a pivot to desired adjusted location, so that the dial and operating nob will be disposed for convenient operation at the rear of the machine.

In order that there will be no accidental shifting of drum 19 during this swinging movement there is slidably supported within sleeve 29, the lock plunger 45. This plunger has the beveled or coned lower end 46 for engagement with the controlling head 47 on the inner end of shaft 34. The inclined shaft 48 of this head is adapted to engage cone point 46 as the shaft is drawn outwardly, to press plunger 45 upward. It further is formed with a peripheral groove 49 to receive and interlock with the point of the pin to aid in holding the shaft in retracted position.

Plunger 45 is provided with the transversely extending pin 50 sliding through slots 51 of sleeve 29 and adapted for interlocking engagement with the series of notches 52 on the under-

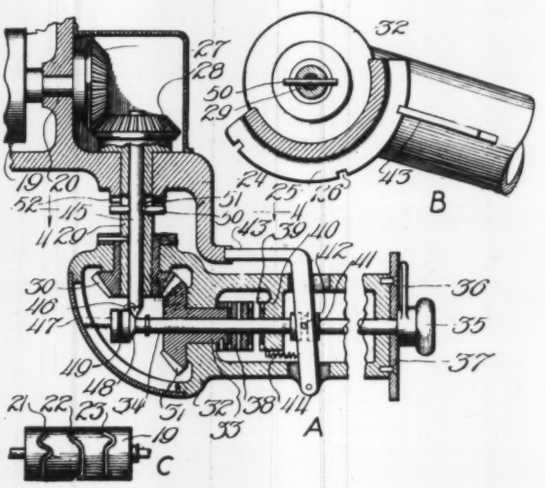


Fig. 4—Control mechanism for milling machine to vary the feed from any working position

side of bracket 24. Consequently, when the plunger is raised by the withdrawing movement of shaft 34, pin 50 by interlocking with the proper adjacent notches 52 will lock the sleeve

6 *reasons why*

TIMKEN is the DOMINANT Bearing on machine tool spindles

1. RIGIDITY: The line contact of Timken Tapered Bearings affords the best possible support for the spindle, the load being carried over the entire length of the tapered rolls and races, thus assuring absolute and permanent rigidity under all speeds and loads.

2. ANTI-FRICTION EFFICIENCY: Timkens roll with utmost freedom and smoothness because of the fine precision with which the rolls and raceways are ground. There is practically no friction. This permits continuous operation at highest speeds. Saves power, lubricant and maintenance.

3. ENDURANCE: Timken Bearings are made of a special grade of alloy steel developed and manufactured in the plant of The Timken Steel and Tube Company expressly for this purpose. Its quality is jealously guarded and never varies.

4. WEAR RESISTANCE: The hardened line contact surfaces of Timken Bearings combined with their free rolling motion reduce wear to an infinitesimal degree.

5. TAKE-UP. PRELOAD: Wear can be minimized but not entirely eliminated. Less than one half of one ten-thousandth of an inch spindle looseness is sufficient to cause chatter. Timkens can be preloaded accurately and easily when necessary without disturbing the geometry of the bearing. Take-up is cheaper than replacement.

6. ALL LOAD CAPACITY: Because of Timken tapered construction, Timken Bearings carry all loads—radial, thrust or both in combination—thus affording full protection to all parts in motion.

You will need all of these advantages on the spindles of your machines. You can get them all only by specifying Timken-equipped. Of the leading manufacturers of heavy duty production machines, who have anti-frictionized their spindles, about 95% have standardized on Timken Bearings.

THE TIMKEN ROLLER BEARING COMPANY, CANTON, OHIO

TIMKEN *Tapered Roller* **BEARINGS**

and thus gear 28 against rotation during the time that clutch 38 is disengaged.

It will be seen that both the cam drum controlling the shifting of the gears and the indicator 36 showing the shifted or adjusted position accomplished by rotation of the shaft are both positively locked against individual rotation when the connecting clutch for the transmission line is disengaged. This means that in all adjusted positions there will be a proper dial reading for the cam drum adjustment, and accidental relative shifting of the parts from the transmission line is prevented. The number of the new patent is 1,825,719.

Review of Noteworthy Patents

Other patents pertaining to design are briefly described as follows:

HYPOID GEAR—1,826,852. A pair of tapered gears meshing with axes nonintersecting and nonparallel, each of which is provided with longitudinally curved teeth having generated side tooth surfaces. Assigned to Gleason Works, Rochester, N. Y.

ENGINE CONSTRUCTION—1,828,745. Cylinder construction for sleeve valve engines comprising in part a lower member formed with an upwardly extending cylinder portion provided with intake and exhaust ports. Assigned to Continental Motors Corp., Detroit.

SHAFT BEARING—1,827,409. Covering a bearing, a shaft having a beveled shoulder inclined toward the bearing, a cap for the bearing with an opening therethrough for the shaft which is suitably spaced from the shaft opposite the shoulder to maintain a capillary seal, the shaft having an air vent groove under the seal. Assigned to Crocker-Wheeler Electric & Mfg. Co., Ampere, N. J.

FEEDING MECHANISM—1,817,727. This device is designed for sewing machines, its object being to provide a mechanism wherein the means for raising and lowering the feed dog includes a strap or link connected at one end to a part rigidly attached to the feed bar, and connected at its other end to the actuating member rotating in a circular path about a fixed axis. Assigned to Union Special Machine Co., Chicago.

ADJUSTING APPARATUS—1,811,880. Relating to pedestals of motion picture machines, the patent covers a support comprising a bracket having means for attachment to pedestal, the bracket having an angularly extending bore adapted to receive an adjusting screw for controlling the angular position of the machine, and having a downwardly extending bore adapted to receive a pin carrying a motor table. Assigned to International Projector Corp., New York.

LOCK NUT—1,829,017. A nut having a groove in one face to hold a spring pawl bar bowed outwardly away from the face of the nut so as to engage an abutment. By engagement with the abutment the spring is flexed inwardly into the groove, the side walls of the groove overlying the opposite inner end portion of the spring pawl bar thereby to oppose outward displacement of the end portion under flexing stresses imposed upon the outer end of the bar. Assigned to Saben Lock Nut Co. Inc., Taunton, Mass.

MEN OF MACHINES

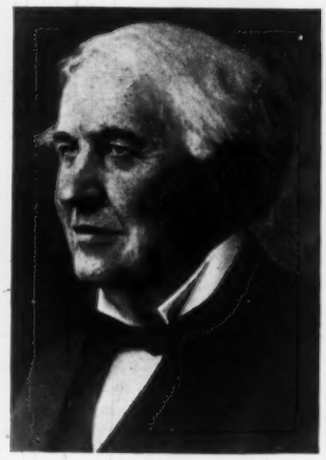
(*Concluded from Page* 52)

announced by the American Section of the Society of Chemical Industry, a British organization. The selection of Dr. Redman, who is president-elect of the American Chemical Society, was based upon industrial studies.

* * *

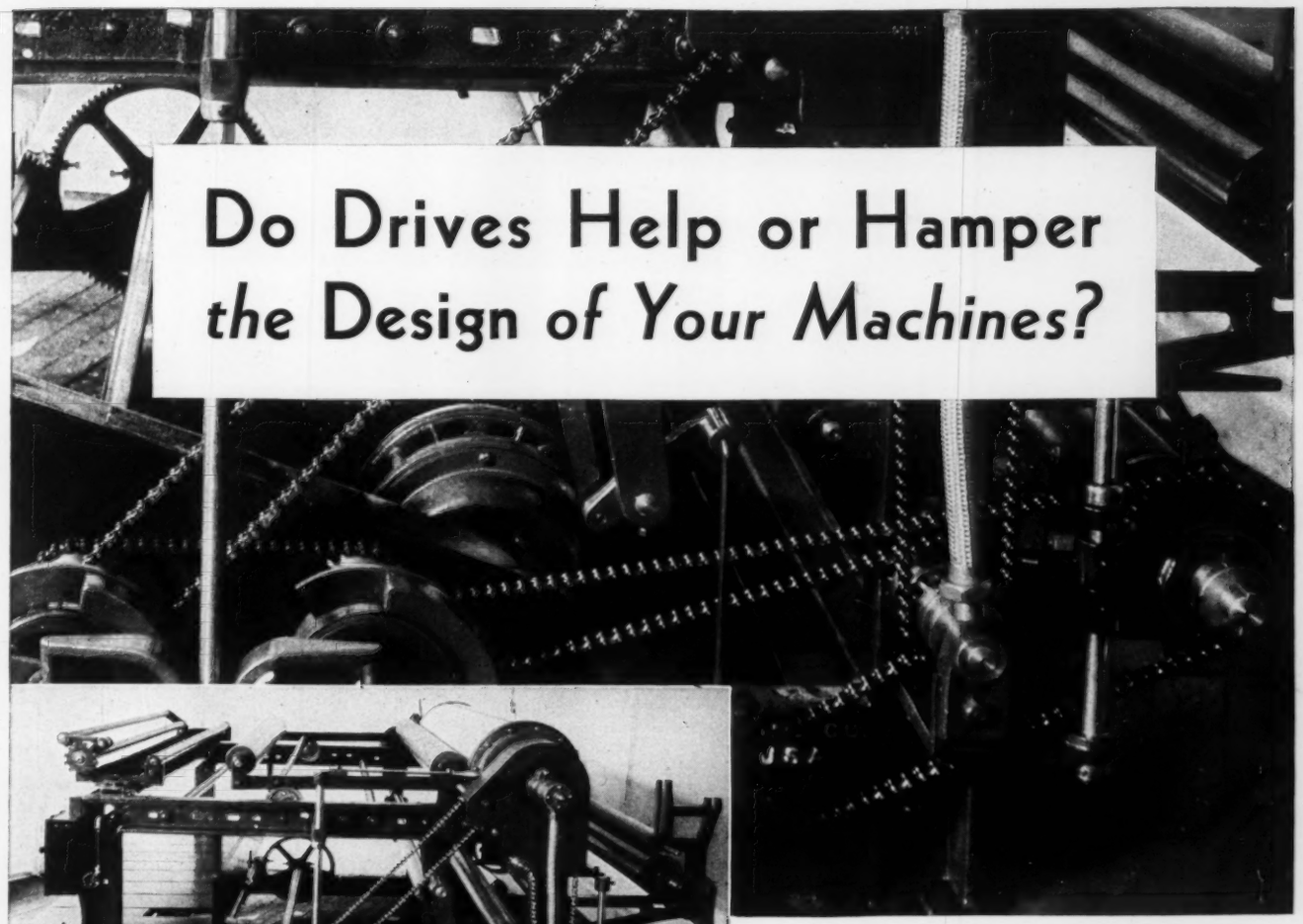
Harold A. Everett, professor of thermodynamics at Pennsylvania State College since 1922, has been appointed head of the department of mechanical engineering at Penn State, to succeed Prof. Arthur J. Wood, who was killed by a motorcycle last April.

THOMAS ALVA EDISON, who died Oct. 18 from a complication of diseases after a lingering illness, leaves posterity a singular example of a fruitful life. Born 84 years ago in the little Ohio town of Milan, he was destined to become America's most prolific inventor and greatest scientist. At the age of 11 he began to sell newspapers and produce to obtain money for his experiments. When he reached 29 he already had become famous and moved his laboratory to Menlo Park, N. J. It was there that he invented the incandescent lamp and became known as the "Wizard of Menlo Park." Edison's invention of the "speaking machine" was a world sensation but was only one of the hundreds of new devices he designed. Throughout his entire life he was constantly conducting research and making discoveries. During his last years he was engaged in the study of making rubber from the goldenrod.

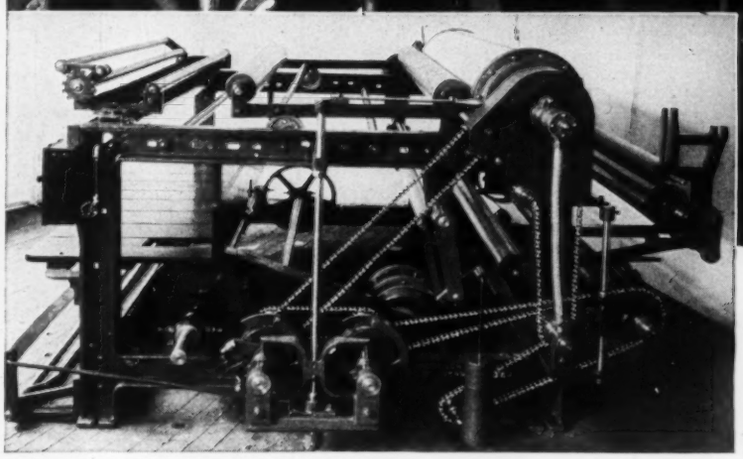


* * *

Dr. Samuel W. Stratton, renowned physicist and chairman of the Massachusetts Institute of Technology, died at the age of 70, the day following the death of Thomas A. Edison. His death was sudden and occurred just after he had completed dictating a tribute to the inventor, his close friend with whom he was associated as advisor on the Edison scholarships. Dr. Stratton was a former director of the bureau of standards. His biographical sketch and photograph appeared in the May, 1930 issue of MACHINE DESIGN.



Do Drives Help or Hamper *the Design of Your Machines?*



An example of the flexibility of Diamond Roller Chain Drives—a Decatur machine manufactured by the Parks & Woolson Mfg. Co., Springfield, Vt.

"IT belongs there, but we can't drive it there"—too often the limitations of drives force this compromise in arranging units of a machine. But by standardizing on Diamond Roller Chain Drives, logic, not necessity, can rule design.

Diamond Roller Chain Drives are flexible, can be run *over* or *under* any number of sprockets—and on short or long centers. They are compact and light in weight for their capacity and transmit 98–99% of applied power continuously.

Diamond Drives incorporate the roller-bearing principle which "sheds" wear, holds original speed and efficiency, keeps down maintenance. Thus, the most complicated main or auxiliary,—slow or high speed drive problem is quickly solved by the decision to use Diamond.

The 8 classes of applications on which Diamond Roller Chain Drives serve better are described in the Booklet 104-B *"Simplifying and Improving Machine Design."* Mail the coupon.

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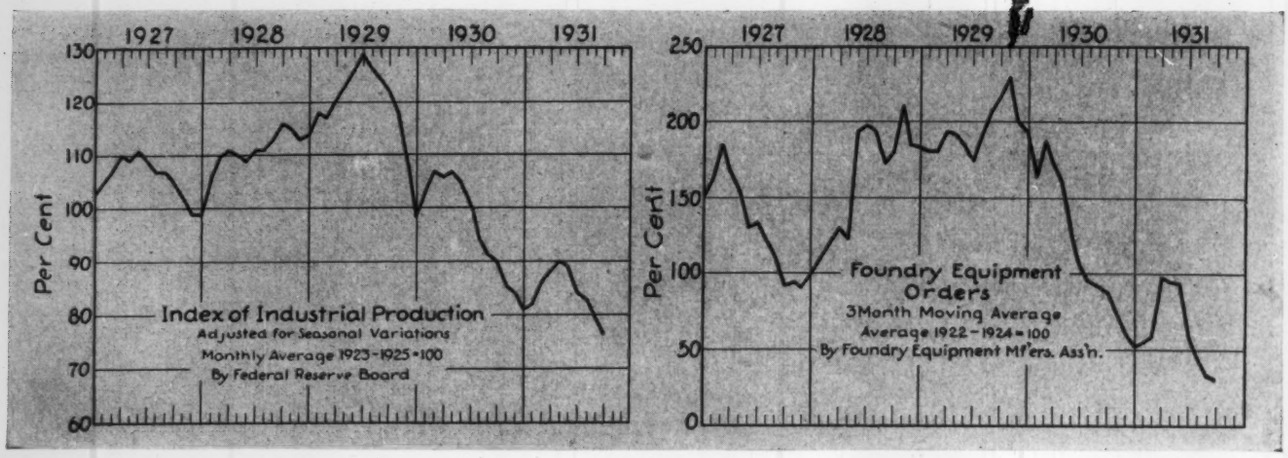
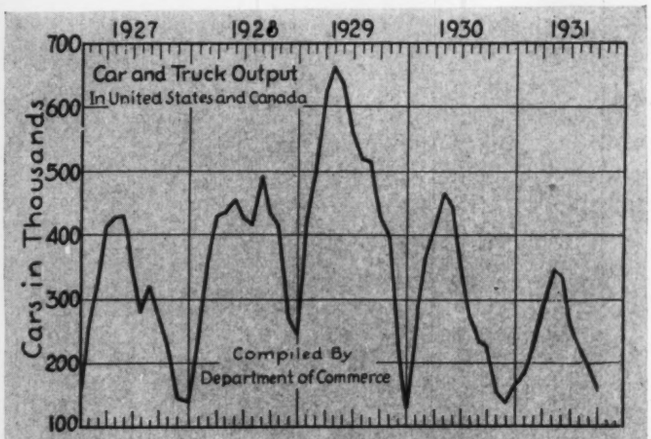


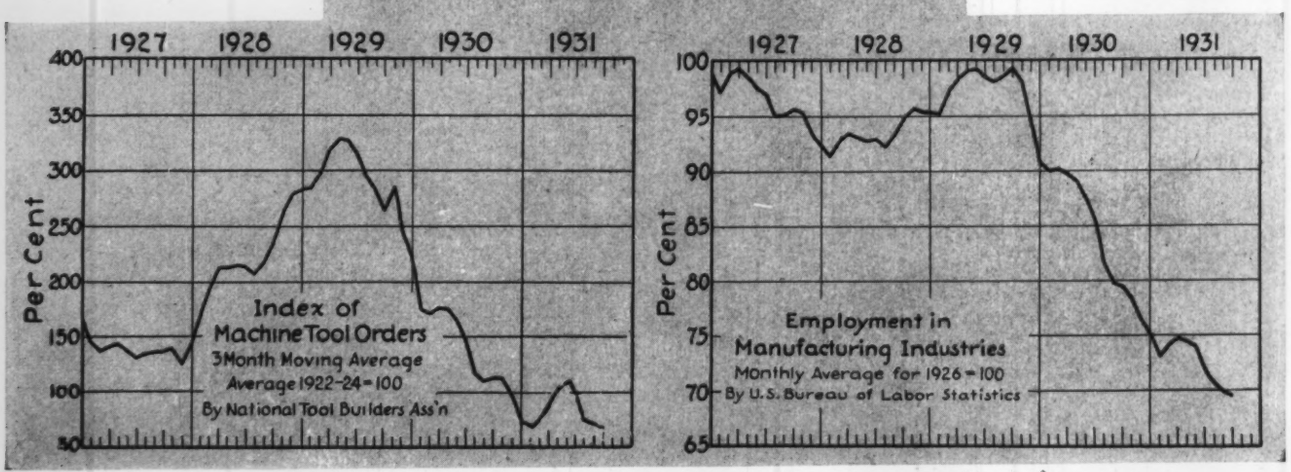
How Is Business?

IF ANY one of the hundreds of business predictions made in the spring of 1931 were correct, the report summarizing conditions in September would be a joyous saga heralding the evidences of a definite upturn. Unfortunately, however, business missed its turn and is still coasting downhill, although the efforts of President Hoover and other world leaders are slackening the speed of its decline.

One of the most favorable of the many signs believed to be the true prophet of better times is the index of commodity prices. This bell wether has been holding steady for the past four months, a most hopeful indication in view of its previous weakness. Another bright star is the index of raw material prices which has been moving upward. This is especially of interest as an increase in this line will increase the farmer's buying power and it is from this quarter that the greatest reduction has come.

Reduced farm earnings have found a sensitive response in the earnings of factory workers in plants making farm equipment. In this line, earnings in September were 58.6 per cent lower than a year ago, the greatest decline in any one division. Second place in the record of reduced factory earnings was the machine tool industry, while the decline in the automobile plants was considerably greater than the average for all groups. The curtailment of automobile production in September was a major factor in the general decline of business activity for that month.





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High-Torque Motor

Replaces an Old Method

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Helps Sell Modern Car Puller!

Here is the specially designed L.A. motor, with base and pinion, ready to be installed as the "back-bone" of the car puller shown above.

No need for the old back-breaking "pinch bar" method of "spotting" cars, with this modern car puller. Driven by a Louis Allis motor "fitted to the job," this machine transforms a hard two-man job into an easy one-man job.

Louis Allis motors *help sell* modern production machinery because they enable machines to do more work, easier, better, at lower cost. Build better performance and greater sales appeal into your machines through modern motor application. Consult L.A. engineers.

Write for bulletins on L.A. "Custom-built" motors.

Prompt Deliveries. **Nation-Wide Service.**

LOUIS ALLIS

"CUSTOM-BUILT" *Electric* MOTORS

THE LOUIS ALLIS COMPANY

MILWAUKEE, WIS.

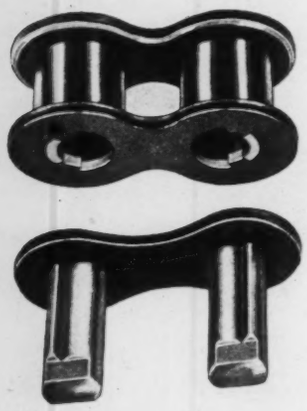
Motor Specialists Since 1901 ⁂ *Offices in Principal Cities*

NEW MATERIALS AND PARTS

Worthy of Note by Those Engaged in the Design of Mechanisms or Machines

Chain Has Unique Joint Construction

ROLLER chain which has a distinctly different joint construction than that common to other types has been introduced by Morse Chain Co., Ithaca, N. Y. Within the roller there are two joint members, a segmental bushing and a pin. The cross section of the pin is that of a round pin integral with a segmental bushing. On account of this construction, when a chain is flexing on or off a sprocket, all sliding movement of surfaces under load occurs between the roller and the joint members. This feature insures uniformity of pitch throughout the life of the chain, and, therefore, smoother and quieter operation.

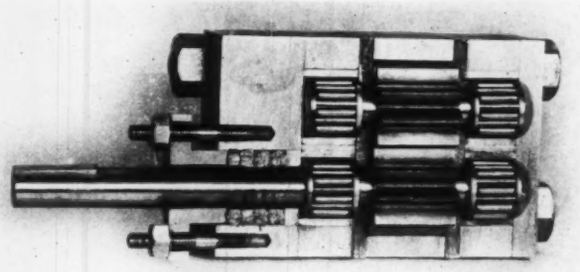


Component parts of unique roller chain. Segmental bushing is employed instead of the usual circular bushing

The open spaces between the joint members of the chain, shown herewith, provide reservoirs for oil and lubrication and are made more effective by the "pumping" action when flexing. The chain is made to manufacturers' standards and is interchangeable on all standard roller sprockets.

Introduces Larger Nitralloy Pumps

PRECISION rotary pumps with capacities from one gallon per minute to 15 gallons per minute have been developed by Northern Pump Co., Minneapolis, to supplement its line of nitralloy pumps. This new series, known as the XD series, is the next larger size to the first group of XA pumps built of nitralloy steel. Nitralloy bearings for supporting the shafts are used in pumps to handle fuel oil, gas oil, glucose, coolant, or any other liquid with little or no lubricating value. Roller bearings are incorporated in the pumps to be used for handling clean lubricating oil, especially for high pressure conditions such as 1000 pounds.

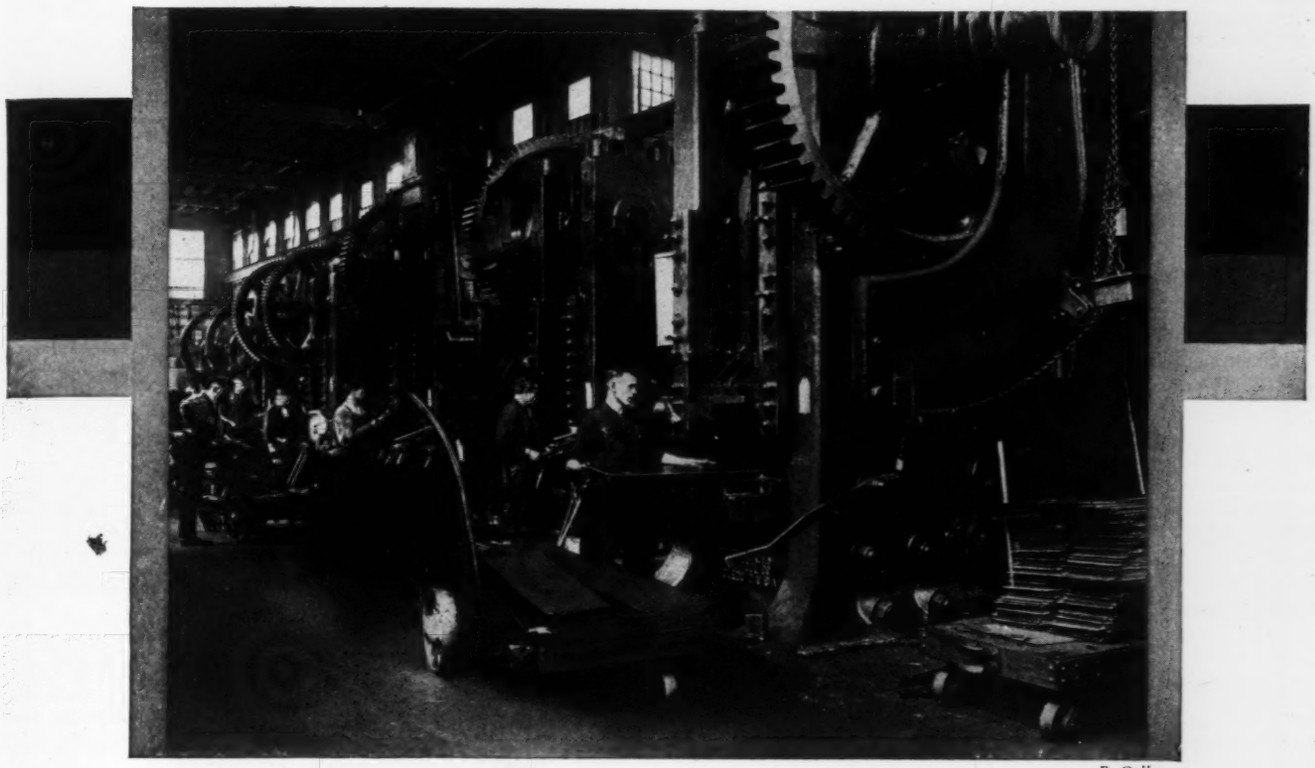


Larger series of Nitralloy pumps have capacities from 1 to 15 gallons per minute

Because of the extreme resistance of the nitralloy steel used in the pumps shown herewith, they will last indefinitely, even when there is a small amount of foreign matter in the pumping system. The high efficiency and wear resisting qualities fit these pumps for use with hydraulic hoists, dump trucks, stokers, cranes, conveyors, presses, bulldozers, snow plows, road machinery and machine tools of all kinds requiring hydraulically actuated feeds, chucking and table travel and handling of coolant solutions.

Offers Processed Malleable Iron

PROMAL, a specially processed malleable iron, which has been used for some time by Link-Belt Co., Chicago, in its products, now is being offered by the company in the form of castings produced to the requirements of other manufacturers. The process employed in the manufacture of this material transforms it into a metal of radically different microstructure and physical properties. It is not a partially annealed malleable iron, and does not depend for its production on arresting an annealing cycle at a certain point in cooling. The manufacture



E. Galloway

Alloy Steel Assures Dependable Performance

THE flow of production in your plant runs smoothly only when each unit of equipment does its work without interruption. Dependability of performance has real dollar value. It is reflected in your earnings.

Alloy Steels and Irons properly utilized in the design and construction of equipment keep each unit on the job and hold it to its specified performance task.

In these metals you can have increased strength, rigidity and stamina combined with light weight. You can have multiplied resistance to wear, corrosion, heat, acids, shock or fatigue. You can have dependable performance under the most severe operating conditions.

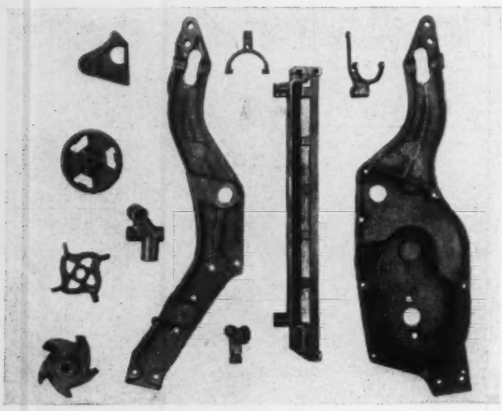
Electromet engineers will gladly explain how these superior physical properties are obtained by the skillful use of Ferro-Alloys.

ELECTRO METALLURGICAL SALES CORP.
Unit of Union Carbide and Carbon Corporation
Carbide and Carbon Building, 30 East 42nd Street
New York, N. Y.

Electromet
Ferro-Alloys & Metals

starts with a uniform raw material, which is treated to produce a uniform product throughout.

The yield point in the material is exceptionally high, indicating its ability to withstand heavy loads without permanent distortion. This property combined with its high fatigue strength and elongation indicates that it will withstand these loads not only once, but a countless number of times without failure. Some of the physical properties of the usual type of the material are: yield point, 50,000 pounds per square inch; ultimate strength, 70,000 pounds per square inch; fatigue strength, 33,000 pounds per square inch; brinell hardness, 170 to 190; and modulus of elasticity, 26,000,000.



Types of castings that can be made from specially processed malleable iron

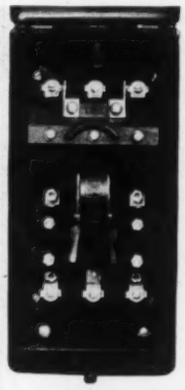
By the addition of suitable alloys, Promal can be supplied with exceptionally high physical properties and wear values. Copper can be added where high corrosion resistant properties are desired.

Starting Switch Has Silver Contacts

FOR use with general purpose motors and with pedestal mountings General Electric Co., Schenectady, N. Y., has announced a new motor starting switch designated CR-1062-C2. The switch, shown herewith, is adaptable particularly for application in the textile industry. It is of the three-pole type with double break silver "umbrella" shape contacts of strong construction. Molded arc chutes supporting the movable contacts totally enclose the contact tips and all arcs. The double break silver contacts reduce arcs to a minimum even with a maximum horsepower load and with the motor rotor stalled, thus providing a high factor of safety.

Thermal overload relays are of the solder film ratchet type and are enclosed to prevent damage to the switch from short circuit. They may be removed readily from the front of the switch. Relay heaters are built into molded cases which have protected sides safeguarding the heaters from mechanical injury. The overload relays and relay heaters being enclosed are suitable for effective group fusing.

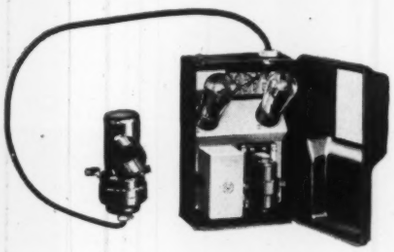
The operating mechanism has a snap action and trips free on overloads. If an overload operates to trip the switch, all three poles will open it. The switch also protects the motor against single phasing. The mechanism within the switch is positive so that vibration will not cause the switch to trip.



Motor starting switch is of the three-pole type with double break silver contacts of strong construction

Develops Photoelectric Relays

INTERRUPTION of a beam of light from some fixed source causes the operation of the new bulletin 880 photoelectric relay, developed by Allen-Bradley Co., 1311 South First street, Milwaukee. The relay, shown herewith, is applicable to various devices, such as counting relays, limit switches, alignment controls, sorting devices, position indicators, safety devices, and many others. The relay is operated by a change in intensity of light from a suitable light source, a change of 10 foot-candles being required for positive operation, and the light may be either direct or reflected.



Photoelectric relay can be operated by a change in light intensity of 10-foot-candles

A photoelectric tube, which is connected to the amplifier tubes and relay through a flexible connecting cord, is placed in the path of the beam of light, so any object moving between the tube and the light source interrupts the beam and causes the relay to operate, thereby either clos-

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FEDERAL Ball Bearings are built to meet any condition of service in all industries and products using ball bearings. "Federals" are made of the finest high carbon chrome alloy steel. They easily withstand the most severe usage .... overloads, high speeds and sudden shocks. The endurance of Federal Ball Bearings is highly valued by engineers who seek dependability regardless of price.

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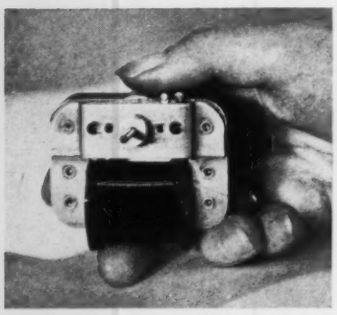
ing or opening the control circuit. By adjusting a condenser, the relay can be made to operate at various values of light intensity. No appreciable power is consumed when the relay contacts are open. The capacity of the contacts is 10 amperes at 110 volts, alternating current noninductive load.

A lighting unit for use with the relays up to a distance of 30 feet, known as bulletin 875 light source, is shown in an accompanying illustration. It consists of a plano-convex lens, with a socket to receive an automobile lamp, all enclosed in a cabinet of pressed steel. The cover and lens mounting can be removed by loosening one set screw. This light source when used on power and light circuits, requires a transformer for stepping the line voltage down to 6 volts. A transformer can be furnished with the equipment. The lens projects a beam of light of approximately parallel rays, which fall on the photoelectric cell of the relay.

Light source for operating photoelectric relays is suitable for use up to 30 feet distant from the relays

Designs Small Electric Motors

FRACTIONAL horsepower motors no larger than the palm of one's hand, and with usually high power output for their size, have been developed by Barber-Colman Co., Rockford, Ill. These motors are furnished for either unidirectional or electrically reversible rotation, and are made for any voltage between 10 and 230, and for alternating current frequencies from 25 to 60 cycles. Special two-speed models of the motor can be furnished.



Fractional horsepower motors have unusually high power output for their size

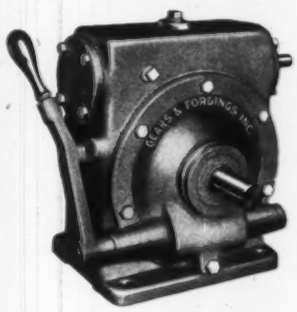
The motors, shown herewith, are constructed ruggedly of steel laminations, brass bearing plates with oilless bearings, and a squirrel cage rotor upon a hardened shaft. All coils are wound on phenolic resin spools and impregnated to exclude moisture and insure good insulation.

The motors are used in modern electric fans, heat regulators, moving picture projectors, unit heaters, and numerous other applications where high starting torque and small size are an ideal combination.

Reduction Units Provide Two Speeds

TWO-SPEED worm gear reduction units, designed for either horizontal or vertical drives of ⅛-horsepower and up where two speeds are required, have been introduced by Gears & Forgings Inc., Cleveland. This type of speed reducer, shown herewith, is manufactured integral with motor or as a separate reduction unit in ratios ranging from 4:1 to 150:1.

The unit consists of a worm and worm gear, a set of differential gears, the driving shafts and their bearings, all enclosed in a sturdy leakproof and dustproof cast housing. The two speeds are obtained by means of the differential gearing. The high speed is obtained by moving the small hand lever to the right. This locks the differential to the low speed shaft on which the worm gear and differential gearing rotate as one unit. Movement of the hand lever to the left locks the side gear of the differential preventing its rotation. Thus one-half of the revolutions of the worm gear are imparted to the slow speed shaft. Change of output speed can be made while the unit is in operation under full load.



Worm gear reduction units are manufactured integral with motor or as a separate unit

Attachment Cap Is Unbreakable

MANUFACTURED of soft, resilient rubber with the blades fastened to a Bakelite disk imbedded in the rubber base, a new attachment cap with hand grip announced by Cutler-Hammer Inc., 328 North Twelfth street, Milwaukee, is absolutely unbreakable. The hand grip of the plug, shown herewith, is narrow and slim, approximately 1¾ inches long. It is claimed

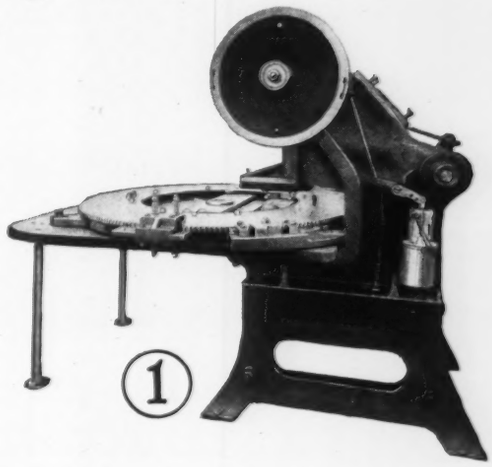
The G-E THRUSTOR—

an electric device that produces straight-line motion with a smooth, powerful thrust

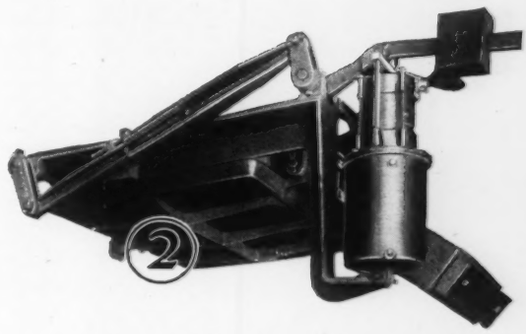
① Reduces Effort

② Simplifies Operation

③ Increases Production

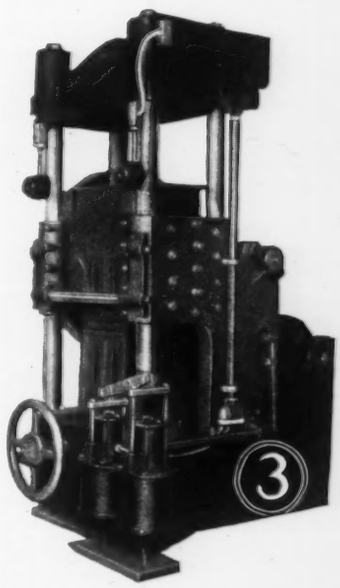


HERE are three applications where the new G-E thrustor is [1] reducing physical effort, [2] simplifying operation, [3] increasing production:



① Here, where a thrustor has been installed in place of a pedal, all operations are now directed by push-button control. Physical effort has been reduced.

② These batch gates originally were operated manually. Now the G-E thrustor permits them to be operated automatically from conveniently located push buttons — greatly simplifying operation.



③ Formerly the operator of this embossing press stood beside the machine and threw a mechanical clutch in and out. The thrustor now enables him to load the machine, push a button, and then go to another machine while the first is performing automatically. Production in this case has been substantially increased.

You should have complete information on the G-E thrustor — and Bulletin GEA-1262A will give you just that. Ask your nearest G-E office for a copy.

301-84

GENERAL ELECTRIC

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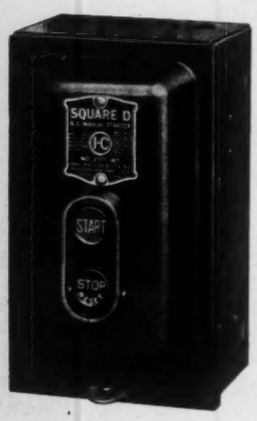
the resiliency provided by the rubber handle will act as a strain relief protection to the cord, as well as protecting the cord from breaking directly at the cord hole.

The artistic design of the handle, and the prevention of scratching or marring surrounding objects because of the rubber construction, makes the plug especially adaptable for domestic uses. The unbreakable rubber construction is of interest for industrial applications as well as for home use. Rated at 15 amperes, 125 volts, 10 amperes, 250 volts, the plug is available with cord openings for 11/32 and 13/32-inch cords. The plug is known as catalog 7761.

Unbreakable attachment cap is made of soft, resilient rubber

Starter Controls Low Power Motors

A COMPACT and rugged manual starter of unusual performance, known as class 2510 W5, has been introduced by the industrial controller division, Square D Co., 710 South Third street, Milwaukee. The three pole starter, shown herewith, is designed to control across-the-line single and polyphase motors of 2 horsepower or less. Although particularly adapted to fan, blower, pump, air compressor, machine tool and loom installations, it is suitable for general applications where remote control and low voltage protection are not essential.

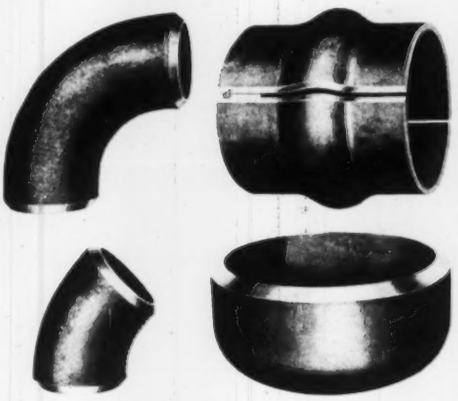


Three-pole starter is designed to control across-the-line single and polyphase motors of 2 horsepower or less

Push button operation, and compactness without sacrificing wiring space are features of the device. Overload protection is provided by the time limit thermal relays which are front reset and require no replacement of parts after operation. Tripping of either relay opens all three lines. The starter is arranged for wall or pedestal mounting. Approximate dimensions are: width 4½ inches, height 7¼ inches and depth 3¾ inches.

Designs Line of Welding Fittings

WELDING fittings that have been subjected to a special compression sizing operation to give exact radius and sectional diameter in perfect round have been developed by Midwest Piping & Supply Co. Inc., St. Louis. The line of fittings includes 90 and 45 degree ells, heads, sleeves, and saddles. Some of these types are shown in the accompanying illustration.



Ells, sleeves and headers for welded construction are sized exactly

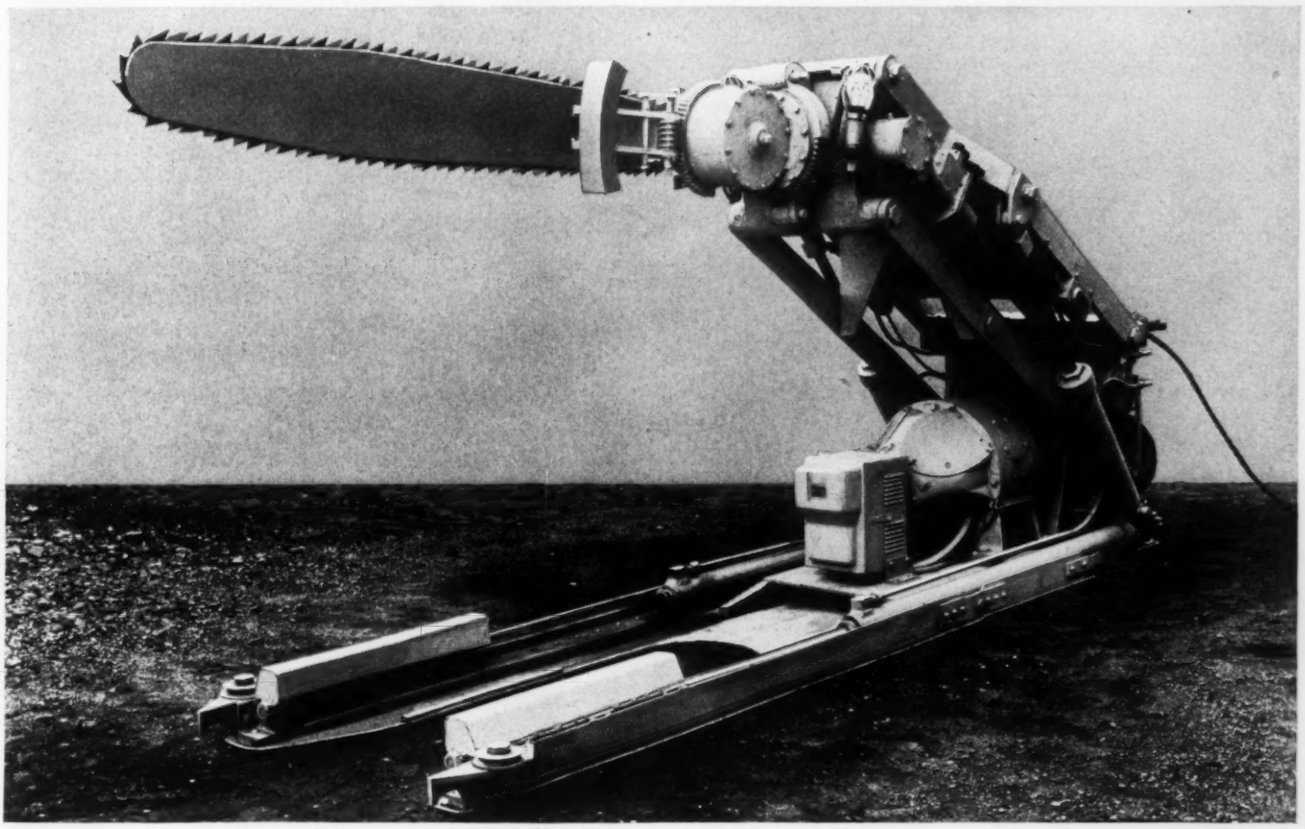
One of the outstanding features of the fittings is the use of tangents which reduce the time and cost of installation. They make it possible to line up the pipe and fitting more quickly and accurately while the welds are more accessible and are removed from the point of maximum bending stress. In the manufacture of the ells, one-quarter inch of tangent is provided for each inch of pipe diameter.

New Alloy Can be Used as Rolled

LOW-ALLOY steels containing chromium, manganese and silicon which can be used as rolled or in the heat-treated condition have been developed by Electro Metallurgical Co., New York. These new alloy steels have been introduced under the name of Cromansil steels, a general term used to designate not one special steel but all steels whose composition comes within the recommended range of alloy content. The most useful forms of the steel contain from 0.4 to 0.6 per cent chromium, 1.1 to 1.4 per cent manganese, and 0.7 to 0.8 per cent silicon, with a carbon content ranging from less than 0.10 to 0.65 per cent, depending upon the particular use to which the steel is to be put.

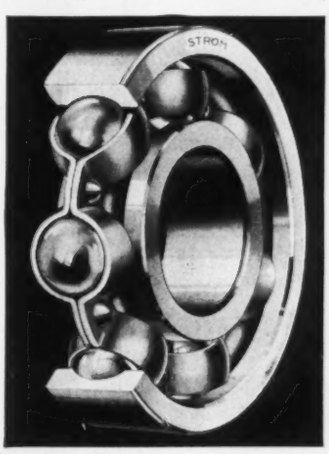
By selecting the appropriate alloy percentages

THIS INNOVATION *in* COAL SAWING



is completely equipped with
29 STROM BALL BEARINGS

WHAT a saw! Biting a long, horizontal cut at the top and bottom of the seam . . . following with two vertical incisions to form a solid block of coal, easily dislodged from the seam without the use of explosives. That's the way the new Joy Bros. Coal Saw does it.



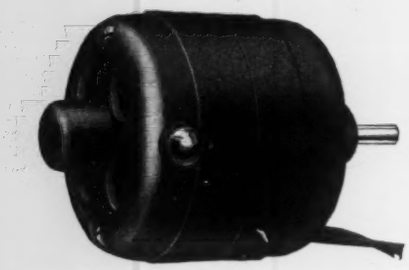
Joy Bros. are old-time users of Strom Ball Bearings. They *know* Strom quality—having proved it in other types of Joy mining equipment. 29 Strom Bearings are used in their new Coal Saw . . . used because of their capacity—long life and ability to hold vital shafts in accurate location. Strom dependability starts with the basic quality of its raw materials . . . is added to by many exclusive design features . . . and terminates in the many tests and inspections that guard each part. You cannot afford to overlook Strom shaft protection that allows your equipment to run at top speed through its natural life . . . that never ties up production or runs up maintenance expense because of bearing wear or adjustments. Strom Bearings Co., Division of Marlin-Rockwell Corporation, 4535 Palmer Street, Chicago, Ill.

Strom BALL BEARINGS

it generally is possible to obtain the desired physical properties without any heat treatment or with a simple normalizing, with or without subsequent tempering. Welding is performed according to the usual procedure control for ordinary carbon steel. The presence of the three alloying elements in combination results in high ultimate strength, great ductility, high fatigue limit, high impact strength, and ready machinability.

Motor Has Mica-Insulated Commutator

A MICA insulated 20-bar commutator is a new feature of the type "V" series universal motor built by Bodine Electric Co., Chicago. Increasing the number of commutator segments from 10 to 20, insulating the segments with high-grade mica, and grinding the commutator on



Special attention is given to lubrication in new unibridge

the bearings eliminates in this motor, shown herewith, the commutation troubles often experienced with small motors of this type. These motors are rated at 1/100 horsepower at 4000 revolutions per minute and are designed for 110-volt service, direct or alternating current.

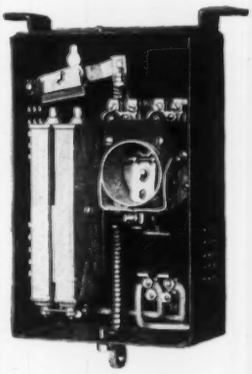
Special attention also has been given to lubrication. The shaft is oiled through a felt ring. At the end of the shaft is a felt-packed reservoir in which lubricating oil is retained over a long period of time and fed slowly to the oil wick through an intermediate felt washer. Any oil which might travel toward the commutator is thrown off centrifugally by a Bakelite protecting ring.

Controller Gives Smooth Operation

SMOOTH control of speeds of sewing machines, small tools, winding machines, etc., driven by direct current or universal motors is provided by bulletin 500 treadle-operated controllers announced by Allen-Bradley Co., 1311 South First street, Milwaukee. Operation of the treadle compresses a graphite-disk compression resistor. This type of resistor allows a stepless variation in motor speed and permits the operator to obtain the exact speed that best suits the nature of the work. Maintenance is virtually nil, as no sliding contacts are employed. A wide range of motor speed control and machine operating flexibility is provided, even with widely varying load.

A self-contained disconnect switch opens the motor circuit with a quick break of the "off" point, and a self-contained short-circuiting switch effectively by-passes the resistance at full speed.

These controllers are made in five sizes, from



Treadle-operated controller is applicable with small machines such as small tools, sewing machines, etc.

1/20 to ½-horsepower. The illustration shows a size D controller for treadle operation, with the cover removed. This size is mounted on the under side of a table or a machine.

Relays Operate on Usual Power

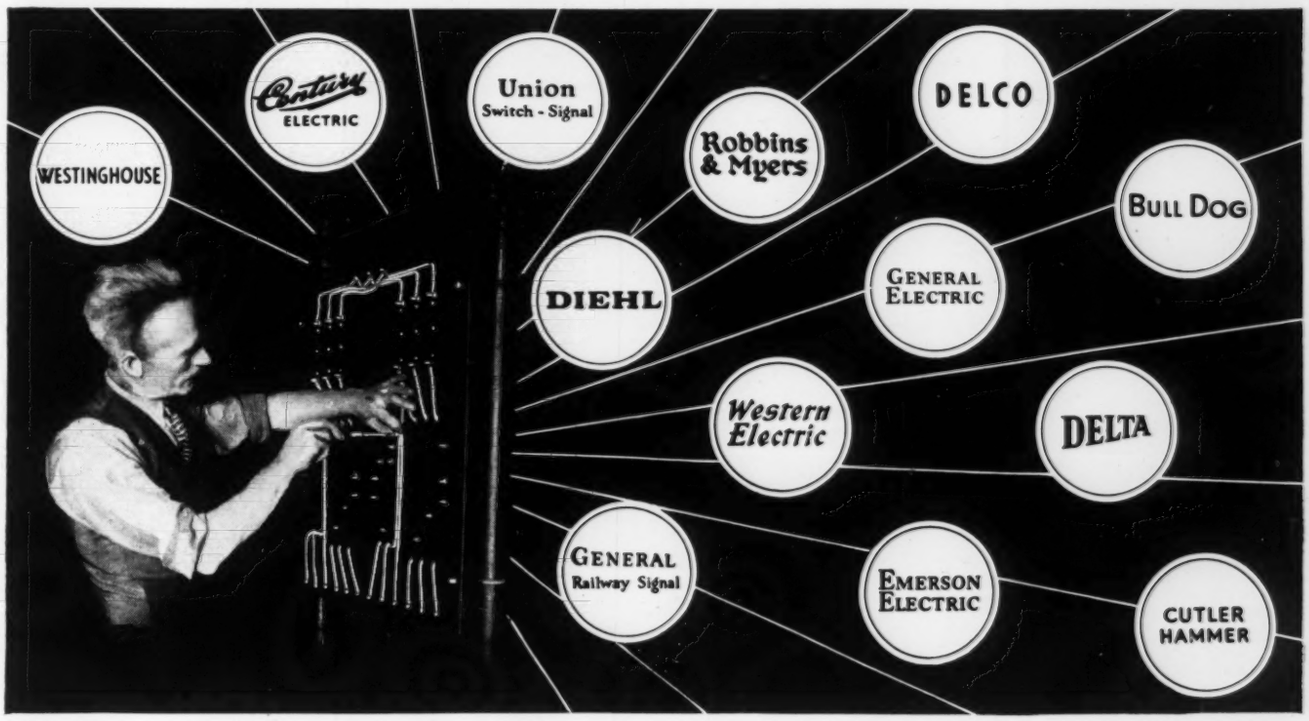
DESIGNED around the radiovisor bridge or light-sensitive cell, the complete, ready-to-use light relay and light source units developed by Burgess Battery Co., 202 East Forty-fourth street, New York, are available in both alternating and direct current models for use on

Interior view of direct current light relay designed around the radiovisor bridge

usual power supplies. The units are in the form of an aluminum housing with window, containing a circular platform on which the bridge, tubes and other components are mounted.

The alternating current unit comprises bridge, two 427 type tubes serving as amplifier and rectifier, respectively power transformer, filter condenser, resistors, by-pass condensers and power relay. The direct current unit, shown in an accompanying illustration, comprises bridge,

MAKERS OF ELECTRICAL EQUIPMENT SAVE IN ASSEMBLING SLATE, EBONY ASBESTOS, BAKELITE, DUREZ, STEEL



Make superior fastenings at lower cost with Self-tapping Screws

Manufacturers who make fastenings to slate, ebony asbestos, Bakelite, Durez and steel can profit by the experience of the leading makers of electrical equipment. For these concerns have solved the problem of making fastenings to such materials securely and economically. They use Hardened Self-tapping Screws and Hardened Metallic Drive Screws.

A cost comparison on a test assembly job, which led to the wide use of Self-tapping Screws by a great concern named above, is sufficient to show the notable economies effected by these Screws. This manufacturer adopted Self-tapping Screws in place of lead anchors and wood screws for the job of fastening cleats and other wiring devices to switchboard panels. Comparison of costs proved that Self-tapping Screws saved $3,120 a year in time, labor and material. A stop watch showed that a workman could make a fastening in 13 seconds less time. Before adopting the Screws for other assemblies, they also subjected them to security tests which demonstrated that Self-tapping Screws actually make stronger as well as cheaper fastenings.

It will pay you to carefully consider Self-tapping Screws for your own fastening jobs. Let our Assembly Engineers tell you whether you can use these Screws to advantage. It costs nothing. Just attach a description of one or more assemblies when you mail the coupon for the booklets below.

Type "Z" Hardened Self-tapping Sheet Metal Screws

For joining and making fastenings to sheet metal up to six gauge; also aluminum, die castings, Bakelite, etc. Simply turn Screw into drilled, pierced or molded hole. It forms a thread in the material as it is turned in. Can be removed and replaced.

Type "U" Hardened Metallic Drive Screws

This type of Self-tapping Screw is used for making permanent fastenings to iron, brass and aluminum castings, steel, Bakelite, Durez, etc. Just hammer the Screw into a drilled or molded hole. It forms a thread in the material as it is driven.

PARKER-KALON *Hardened* Self-tapping Screws

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Send me free booklets on the Security and Economy of assemblies made with Self-tapping Screws.

Name and Co.----------

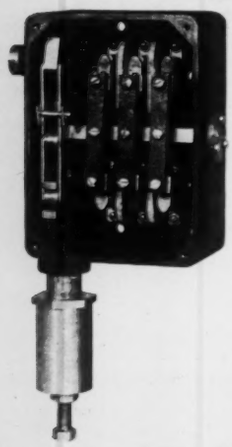
Address----------

one 427 type tube serving as amplifier, voltage reducing and other resistors, by-pass condenser and power relay. The unit housing is held by a wall bracket ring, permitting necessary adjustments to line up the window with the actuating light source. When provided with a vacuum contact, the light relay can control a circuit handling up to 1320 watts.

As companion equipment to the relays, light source units are available in several alternating and direct current models. Each unit contains a 12-volt, 21-candlepower bulb, as well as a focusing optical system to concentrate the light beam on the light sensitive surface of the light relay unit. The light source unit is housed in an aluminum case similar to the light relay unit.

Limit Switch Is Weatherproof

DEVELOPED for general industrial applications, a new plunger type, snap action, weather proof limit switch has been introduced by General Electric Co., Schenectady, N. Y. The switch is adapted particularly for foot operation and may be mounted in any position desired.



Plunger-type limit switch adapted particularly for foot operation may be mounted in any position

It has six separate electrical circuits, three normally open and three normally closed. Each contact arm in the switch, shown herewith, may be removed by taking out a screw for easy access to the terminal studs for connecting the control lines.

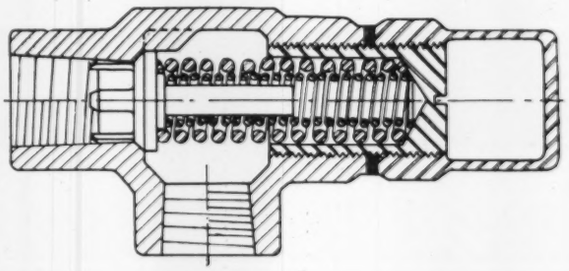
Operation is by a cam and ball mechanism, and gives positive snap action in either direction. The plunger is fitted with two main springs. The returning spring resets the switch in normal position when pressure is removed from the plunger while the overtravel spring compensates for any travel in excess of the half inch required to operate the switch.

As pressure is applied to the plunger, the return spring compresses from a pressure of 26 pounds at 1⅞ inches in length to 45 pounds at 1⅜ inches in length where the switch snaps over.

The normal pressure of the overtravel spring is 50 pounds at 1⅞ inches in length. Consequently, this section will act as a solid member during normal operation. However, in case the adjustment of the switch is not accurate, any overtravel up to one-half inch will be taken up by the spring. A round head set screw and lock nut is supplied as part of the overtravel member for adjusting the switch when installing it.

Announces New Pressure Relief Valve

DESIGNED especially for use in conjunction with hydraulically operated machinery, a new pressure relief valve, introduced by Brown & Sharpe Mfg. Co., Providence, R. I., is adapted particularly to operation in connection with rotary geared pumps manufactured by the company. By removing the hexagon cap and turning the adjusting screw, the compression on the valve springs may be adjusted readily so that the valve may be set to operate at pressures from zero to 200 pounds per square inch. Guides on the valve prevent fluttering and noisy operation.



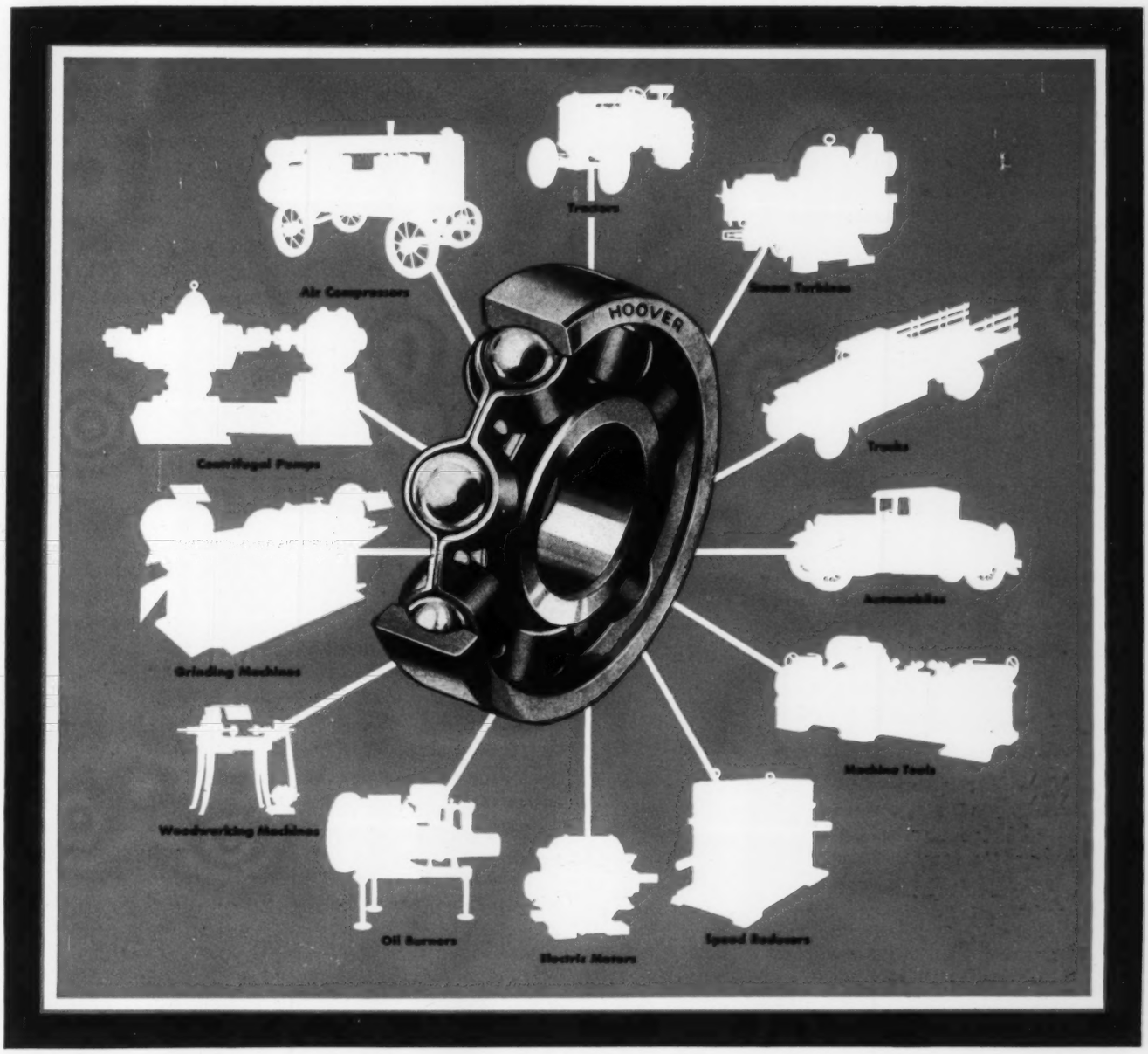
Pressure relief valve is designed for hydraulically operated machinery

Features in the design of the valve are the large valve chamber which permits a ready escapement for the by-passed liquid and the double spring arrangement which gives wide range and flexibility. They provide for quiet and efficient operation of the valve which when once installed and set for a predetermined pressure requires no further attention. The valve, shown herewith, is manufactured to fit 1-inch piping.

Rugged Construction Features Motors

SMALL direct current motors designed to supplement the company's line of larger type T heavy-duty motors, have been developed by Reliance Electric & Engineering Co., 1088 Ivanhoe road, Cleveland. The new motors, shown herewith, are built in sizes from ½ to 3 horsepower, at 1750 revolutions per minute, for constant or adjustable speed operation. They are constructed ruggedly to withstand hard service and unusual strains when necessary. They are provided with ball or sleeve bearing and may be had in either the open, semi-enclosed or fully enclosed construction.

A feature not usually found in such small



IN EVERY LINE OF INDUSTRY

Where heavy loads and high speeds are encountered—where smoothness, quietness and precision are essential, Hoover Bearings are establishing phenomenally successful results.

No better evidence of their true worth—no more fitting tribute to their superior quality could be submitted than the fact that more than 200 nationally known concerns—in virtually every line of industry—are using them as original equipment. This list is growing every day.

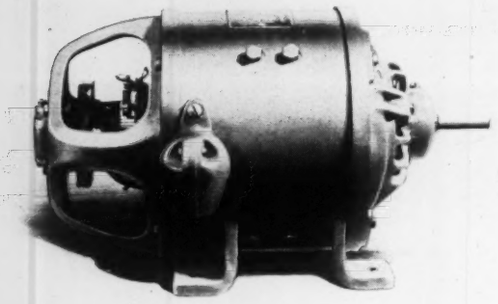
HOOVER

Undisputed Excellence

BALLS ● BALL BEARINGS ● ROLLER BEARINGS

THE HOOVER STEEL BALL COMPANY, ANN ARBOR, MICHIGAN

motors is the refillable-type commutator. If the copper bars should become damaged or badly worn, they may be removed easily and replaced. Another unusual feature for small motors is the

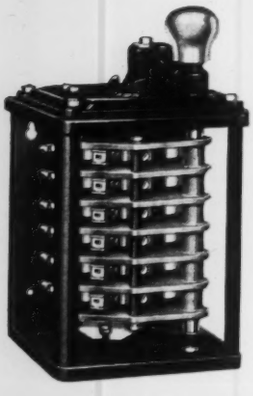


Small direct current motors are available from ½ to 3 horsepower

provision of two brushes per stud. This improves commutation and keeps these power units running longer and steadier with less attention.

Designs Drum Reverse Switches

DRUM reverse switches for across-the-line reversing of alternating and direct current motors and for reversing service in connection with magnetic starters now are being manufactured by Allen-Bradley Co., 1311 South First



Drum reverse switches are manufactured for use in connection with magnetic starters

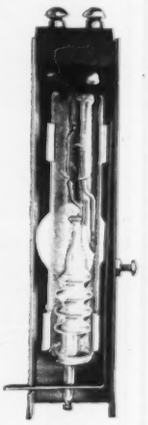
street, Milwaukee. For the direct handling of motor currents, these switches have a maximum alternating current rating of 5 horsepower, 110 volts, 10 horsepower, 220 volts, and 15 horsepower, 440-550 volts, and will handle direct current motors up to 3 horsepower, 115 volts, and 5 horsepower, 230 volts. For reversing service in connection with automatic starters, these direct current ratings are increased. The switches are made in two sizes.

The entire drum, including all contacts, drum segments and terminals, are supported by the top bearing plate which construction allows the enclosing cabinet to be omitted where the switch is to be built into a motorized machine. Contact fingers and drum segments are renewable individually in the larger size of switch, and in the small size the drum sections which carry the segments are renewable. The fingers are positively nonstubbing and self-aligning, and are adjusted easily for wear.

Either size of switch can be furnished with hand lever, with or without spring return, or with rope lever, and in the smaller size a lever for shipper-rod operation can be provided. The switch can be wired for use with limit switches. The smaller size of switch also can be supplied as splash-proof equipment with oil-immersed contacts.

Mounting Facilitates Use of Contact

TO FACILITATE the application of the vacuum contact, described in the October issue of MACHINE DESIGN, to relays and other actuating mechanisms, a mounting unit has been developed by Burgess Battery Co., 202 East Forty-fourth street, New York. The unit, shown herewith, consists of a C-shaped metal casing to protect the glass vacuum contact held in a pair of clips, a connecting link for coupling the actuating mechanism to the extension stem of the contact, and a pair of screw binding posts. An

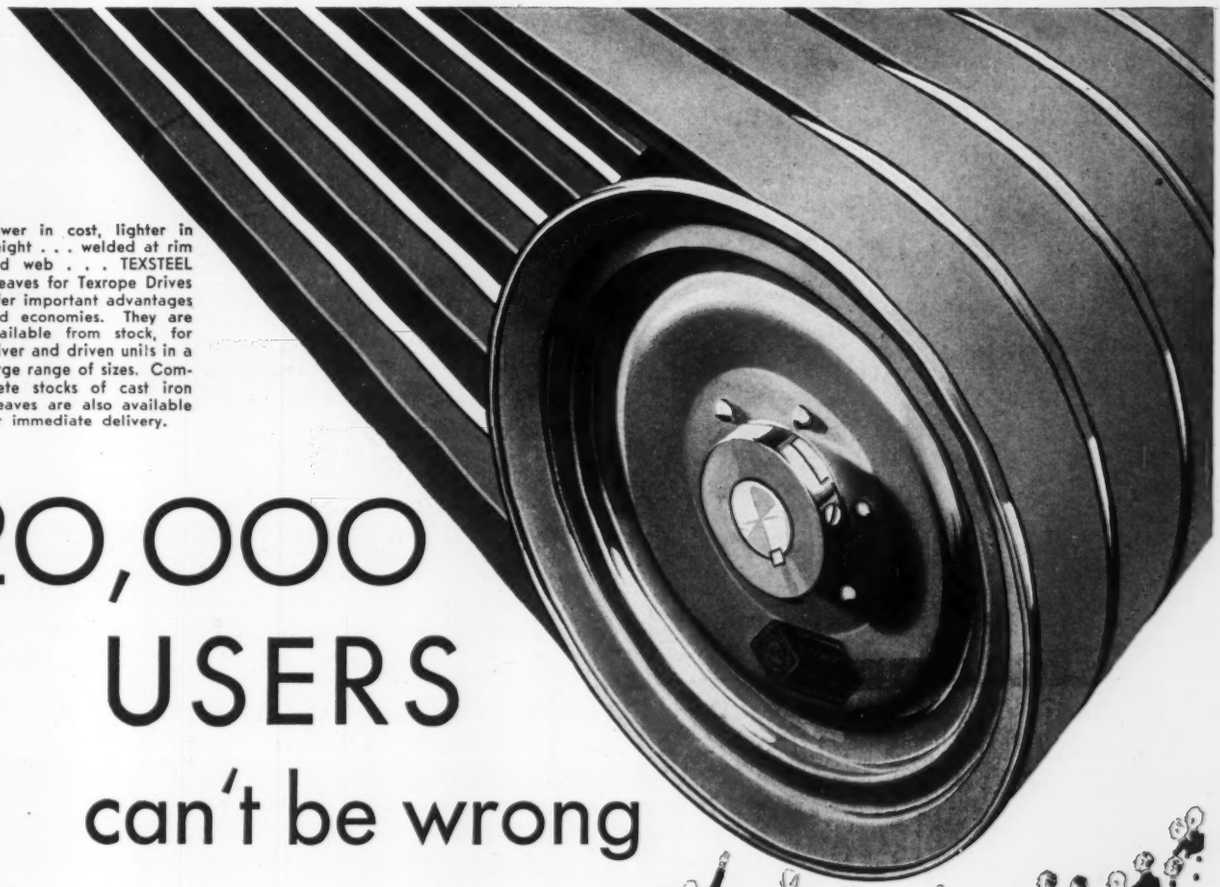


Special mounting facilitates use of vacuum contact

adjustment screw with lock nut permits applying counter pressure to the connecting link in offsetting the inherent spring tension that normally keeps the contact closed when operating as an open circuit device. By rotating the contact one-half turn in its spring clips, it may be operated as a closed circuit device after adjusting the connecting link.

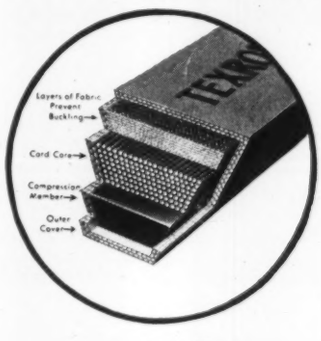
New Chemical Process Provides Better Blueprints

A NEW process for making blueprints and blueline prints, founded upon scientific fact and positive chemical action and reaction, has been developed by C. F. Pease Co., 853 North Franklin street, Chicago. The innovation is designed to operate exclusively on machines built by the company, particularly the newer types of continuous blueprinting equipment, such as mod-



Lower in cost, lighter in weight . . . welded at rim and web . . . TEXSTEEL Sheaves for Texrope Drives offer important advantages and economies. They are available from stock, for driver and driven units in a large range of sizes. Complete stocks of cast iron sheaves are also available for immediate delivery.

20,000 USERS can't be wrong



— another B.F.Goodrich Product

Texrope Belts are made for Allis-Chalmers by Goodrich. They are scientifically designed to give long service . . . to stand up under constant flexing to which they are subjected. The latest type Texrope Belt, here shown, is unusually strong and flexible. It pays to insist upon genuine Texrope Belts . . . for long service at low cost.

Some 20,000 users can't be wrong . . . and over 100,000 Texrope Drives in satisfactory service indicate the outstanding success of this Allis-Chalmers product.

May we remind you that the Texrope Drive, originated by Allis-Chalmers, is the original multiple V-belt drive. More than two years of testing and experimenting preceded its announcement some six years ago. Tested at Carnegie Institute, Texrope Drives proved to be 98.9% efficient . . . and this efficiency is sustained for the life of the drive.

Tested in actual service, *since 1925, in every branch of industry, on all kinds of machines, under excessive heat and cold, moisture and dust,* Texrope Drives have proved practical.

Surprising savings have been made by users who have installed Texrope Drives. They have proved what only time can tell . . . that they save money for their users and give dependable, continuous service with low cost for maintenance.

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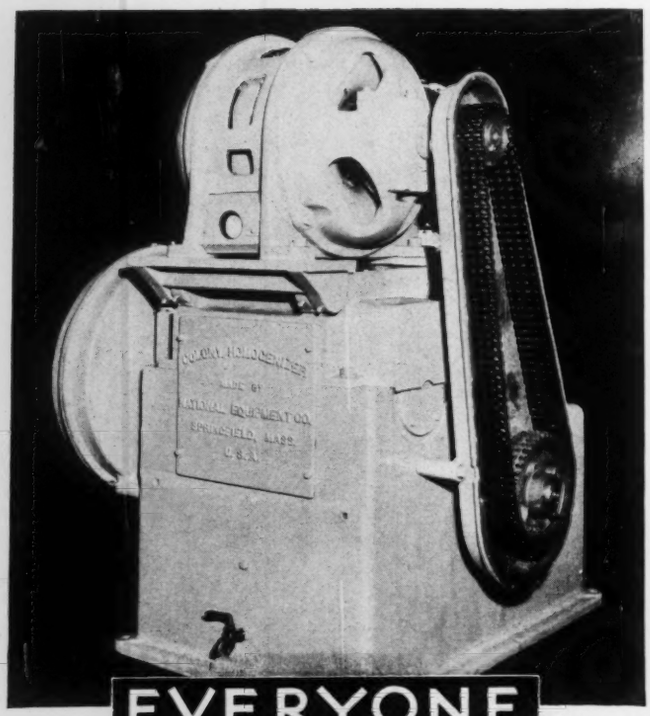
TEXROPE DRIVES

THE DRIVES THAT REVOLUTIONIZED TRANSMISSION PRACTICE • • •



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You will find much of this and other power transmission and conveying chain drive information in the interesting new catalog which is just now being distributed. Send for your copy.

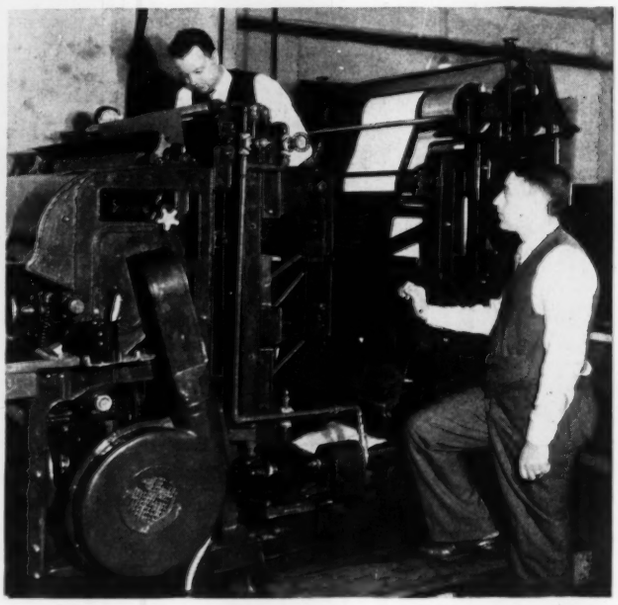
BALDWIN-DUCKWORTH CHAIN CORPORATION
Baldwin Division, Worcester, Mass.
Duckworth Division, Springfield, Mass.

BALDWIN
DUCKWORTH

el 25 described in the September issue of MACHINE DESIGN.

The new process prevents all bleeding and running of blues into whites, thus enabling the operator to make blueprints along with blueline prints. The attachment is mounted directly at the rear of the blueprinting machine, as shown in the accompanying illustration, before the first water wash. Ordinarily only one plumbing connection is required.

Whenever it is desired to discontinue running blueprints or blueline prints in order to run



Attachment for chemical process mounted to rear of blueprinting machine provides better prints of all types

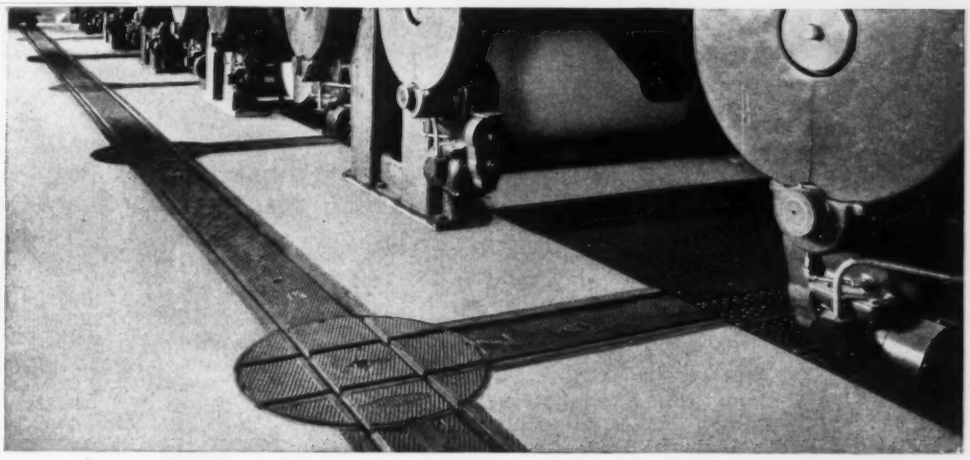
negatives or brownline prints, the process attachment can be shut down and the machine operated in the ordinary manner with hypo developing solution using the revolving roll applicator.

Capacity of the chemical solution tank is ten gallons and when preparing solution for standard operation, chemical is mixed in quantity sufficient for only one day's run.

After preparing the solution the complete mixture is poured into the copper supply tank. Subsequently, the paper is threaded through the process attachment and operation is ready to begin. Tracings and negatives are fed into the blueprinting machine in the usual manner. When the first exposed prints near the top of the attachment, before entering the developer, the process pump at the right hand side of the attachment is started and valves of chemical delivery tubes are opened about half way, sufficient to insure a constant puddle of solution to cover two stainless steel rolls that revolve against the exposed paper. Deep blues and clear whites result from this process.

ON THE FRONTIER OF MACHINE DESIGN . . .

when the news must be out on time



CJB MASTER BALL BEARINGS KEEP THE PRESSES FED

● A thin sheet of paper fed from a tremendous roll into gigantic newspaper presses! Its tension must be perfect—the least deviation might endanger the dead-line, when the paper must be on the street. In the reel room at the new South Side Plant of the Chicago Daily News, feeder tension devices are CJB Master Ball Bearing equipped. The News knows their ability to *perform dependably, faultlessly—for incredible periods of time.* There must not be any possibility of shut-down due to untimely bearing failure. • • • Installations such as this are typical of many where the need of insuring the utmost in quiet, frictionless performance has dictated the use of CJB Master Ball Bearings. • • • The precision, craftsmanship and true custom-building methods under which CJB Bearings are produced make possible the closest tolerances known to the industry. No mass production bearing could offer so much. The CJB design with its deep-grooved raceways and maximum size balls assures a new uniformity in minimum lateral and radial play, together with unusual stamina and superb overload capacity. Perfectly balanced CJB retainers have been especially developed for present day high-speed work. • • • CJB Master Ball Bearings are invaluable as a selling factor for progressive manufacturers in the machinery field because of the enviable reputation they have earned, both for difficult bearing applications "on the frontier of machine design," and for every day dependable performance in normal application. Write to the nearest branch or use the coupon for an interesting booklet, "An Achievement In Precision Manufacture," the story of CJB Master Ball Bearings. • • •

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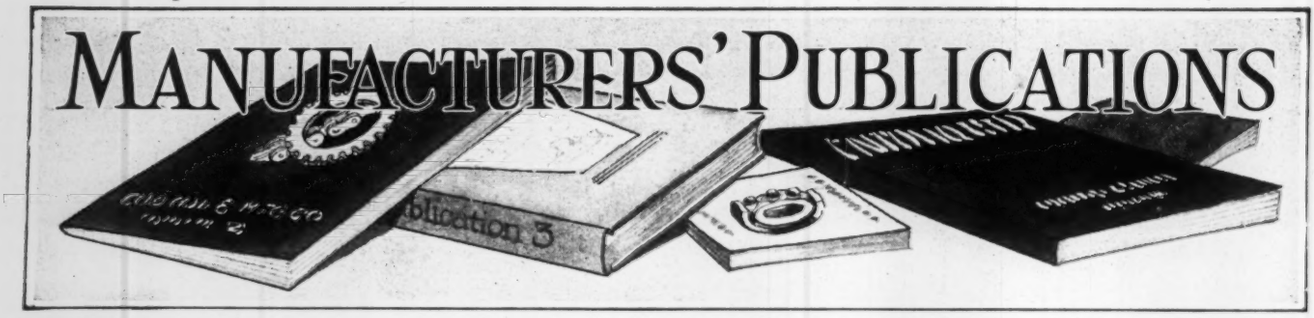

Publications listed in this section may be obtained by engineers responsible for design from the manufacturers of the products or through MACHINE DESIGN

ALLOYS (STEEL)—The properties and applications of certain steels, known as Cromansil steels, containing chromium, manganese and silicon are presented in bulletin No. CMS 1 issued by Electro Metallurgical Co., New York. The bulletin compares this group of steels with other steels, gives typical uses, and the results of extensive tests on the materials. The most widely useful composition of Cromansil steels will have 0.4 to 0.6 per cent chromium, 1.1 to 1.4 per cent manganese and 0.7 to 0.8 per cent silicon.

BEARINGS—Kingsbury Machine Works Inc., Frankford, Philadelphia, has prepared bulletin HV, the first of a new series of bulletins, describing in one booklet its line of vertical and horizontal thrust bearings whose parts are to a large extent interchangeable. Standard self-aligning, equalizing thrust bearings are covered. Capacities, weights, and principal dimensions are given for the usual form of these bearings.

CLUTCHES—Engineering data, descriptions, and dimensions of the line of full floating expansion clutches manufactured by Conway Clutch Co., Cincinnati, are presented in bulletin E-8 of the company.

CONTROLS (ELECTRICAL)—Float switches for use with automatic pumping equipments for water-level control are discussed in a catalog insert prepared by General Electric Co., Schenectady, N. Y.

CONTROLS (ELECTRICAL)—Allen-Bradley Co., Milwaukee, has issued a number of catalog inserts giving complete information on the latest additions to its line of electrical control apparatus. The inserts cover: Bulletin 742 automatic increment starters for network systems; bulletin 555 alternating speed regulators for slip-ring motors with auxiliary contacts for operating primary magnetic contactors; bulletin 350 alternating and direct current drum reverse switches; bulletin 500 treadle operated controllers; and bulletin 715 automatic multispeed across-the-line switches.

COUPLINGS — Morse Chain Co., Ithaca, N. Y., has prepared bulletin 47 which presents in an unusually attractive manner complete information on the company's flexible couplings. Besides a complete description of the coupling and its component parts, the booklet includes tables by the use of which the correct coupling can be selected, typical installations, advantages, and a description of special types.

DIE CASTINGS—"Zinc Die Castings" is the title of a new booklet issued by New Jersey Zinc Co., New York, which attractively presents the rapid strides this material is making in finding application in many new industries. The booklet gives the properties of die-cast zinc, describes many applications; and presents outstanding uses pictorially. A recent research bulletin issued by the same company is on "The Plating of Rolled Zinc and Zinc Die Castings." Although intended primarily as a treatise on the process of plating these materials, the booklet contains information of interest to designers employing these materials and parts.

DRIVES—Morse Chain Co., Ithaca, N. Y., has issued bulletin R 50 describing its recently introduced roller chain drives. This roller chain, which is made to manufacturer's standards and is interchangeable on all standard roller sprockets, has a distinctly different joint construction than that common to all other roller chains.

DRIVES—Belting manufactured by Diamond Rubber Co. Inc., Dayton, O., is described in the new catalog published by the company. Outstanding characteristics of the belting are presented, and illustrated by cross sectional views. Other products included in the catalog are: Packing, hose, mats and matting.

DRIVES—Westinghouse-Wise multispeed drive is the subject of a new illustrated leaflet, L. 20520, issued by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. This drive consists of an adjustable speed reducer built into a standard induction motor. Instant speed changes can be made with the motor running under load. Standard sizes range from ½ to 14 horsepower.

DRIVES—J. E. Rhoads & Sons, Philadelphia, has completely revised its *Belt User's Book* and is now distributing the 1931 edition. The book includes rules, suggestions and information on the use of leather belting. Engineering tables and nomographic charts of value to designers as well as information on minimum pulley diameters, which side to pulley, methods of finding horsepower, length of roll, length of belt, width of belt, and similar material are included.

DRIVES—The engineering research staff of E. F. Houghton & Co., Philadelphia, has prepared an exceptionally able 148-page belt treatise on Vim short center drives. The book contains charts, tables and engineering data on 5000 standards "efficiency" drives ranging from 5 to 100 horsepower. Published originally for use by Houghton's technical field men to assist them in discussing and working out transmission problems with engineers, the book contains all information of value in working out these problems. Copies may be obtained from the distributors of the Houghton company upon application on company letterhead.

ELECTRICAL EQUIPMENT—Ignition transformers for oil burners, electric equipment for foundries and for oil refineries, and switchgears are presented attractively in four new booklets issued by General Electric Co., Schenectady, N. Y. Three other recent booklets present switchgear for merchant ships, and automatic switchgear and associated supervisory systems for railway service and for industrial

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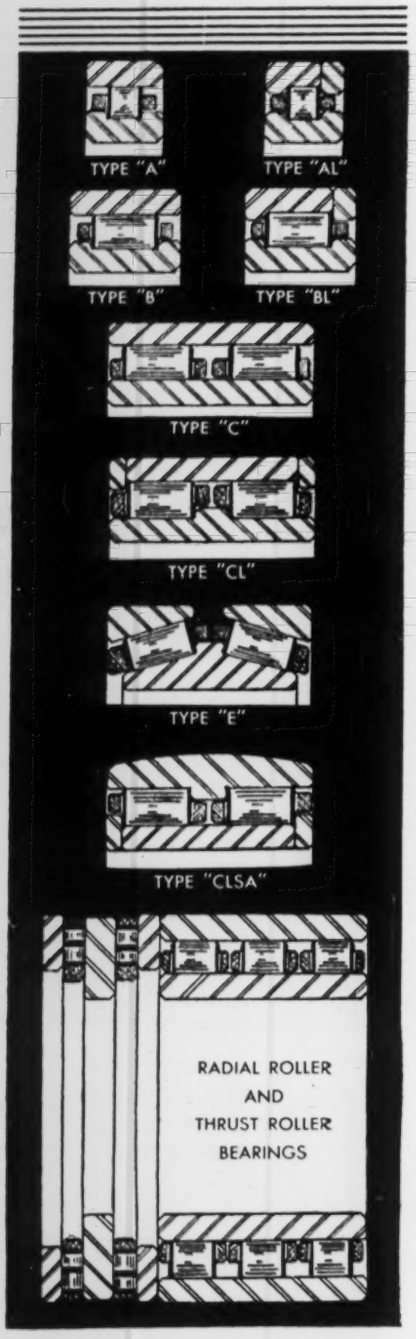

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MANUFACTURERS' PUBLICATIONS

service. The company also has prepared catalog inserts of busbar clamps of non-magnetic steel and malleable iron, test blocks and plugs, round-pattern switchboard instruments, air circuit breakers, directional distance relays, and switchgear accessories.

FINISHES—Protection of steel and metal equipment exposed to severe corrosion including acid and alkaline conditions is provided by a Bitumastic solution described in bulletin No. 505 of Wailes Dove-Hermiston Corp., New York. This coating is a brilliant black, quick drying bituminous paint highly resistant to heat and chemical fumes. It is obtainable in colors, although in this form it is not so suitable for use under extreme heat.

GEARS—Welded steel gears from blanks made by the Lukenweld Inc., Coatesville, Pa., are discussed in a recent booklet of the company. The publication, written by Everett Chapman, director of engineering and research considers the rim, the web, the spokes and hub, metallurgical considerations, quietness, weight and economics. A summary of impact tests on individual teeth also is presented.

LUBRICATING EQUIPMENT—A new system of automatic lubrication whereby the expansion and contraction of air causes the lubricant flow is described in a bulletin of Victor Lubricator Co., Chicago. These lubricators do not work on the thermostatic principle or from "heat" or at any predetermined temperature. A slight rise in temperature starts the flow of lubricant, and a slight drop stops it.

MOTORS—General Electric Co., Schenectady, N. Y., has prepared catalog inserts on general purpose synchronous motors; type SCR single-phase vertical motors; and type SCR constant speed, single phase motors.

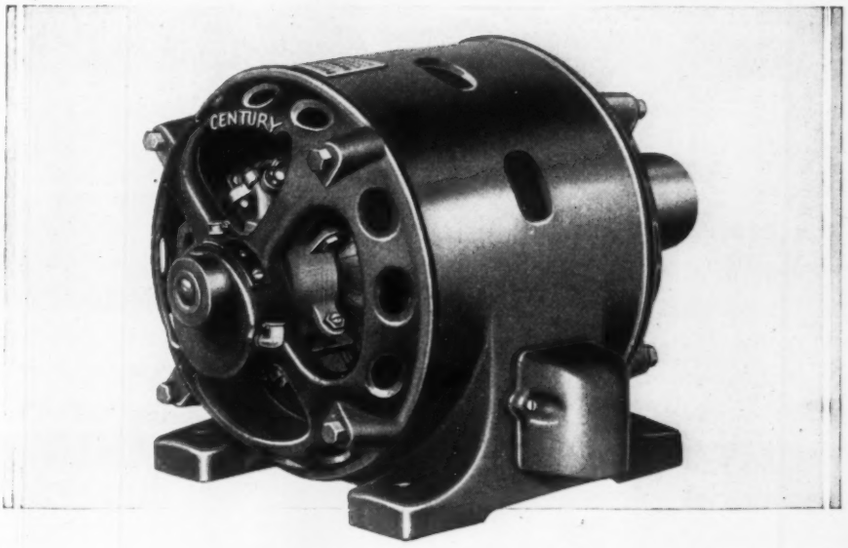
MOTORS—A publication describing new single phase motors has been prepared by Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa. These motors have extensive applications on pumps, compressors, ventilating fans, blowers, farm machinery and similar equipment where high starting and high accelerating torques are necessary.

MOTORS—Reliance Electric & Engineering Co., Cleveland, has issued a well-prepared book on *Profitable Ways to Use Adjustable-Speed Motor-Drive*. The book, No. 1175, describes the adjustable-speed drive and its uses, how the speeds of direct current motors can be controlled, control features that help production, and operation in a box board plant, in textile mills, in steel mills, in paper mills, and in the rubber industry.

PHOTOELECTRIC EQUIPMENT—Allen Bradley Co., Milwaukee, has issued two new catalog inserts describing the photoelectric relays and light sources manufactured by the company. This equipment is bulletin 880 photoelectric relays and bulletin 875 light sources for photoelectric relays.

WELDED PARTS—"Arc Welding in Industry" is the title of a new booklet issued by General Electric Co., Schenectady, N. Y., which presents the advancements in the art of welding, uses to which this method has been applied and similar information.

THEY KEEP A-RUNNING



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